NATURE

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The Scientific Value of Expeditions

THE rescue of the Soviet scientific workers from their drifting ice-floe by the use of two ice-breakers brings to an end one of the most striking polar expeditions of recent years, and one that it is confidently believed will be of considerable scientific value. Any sensational character that this venture may have had was due not to an attempt to accomplish a difficult and hazardous feat as an exhibition of mere physical prowess but to the necessity of adopting a dangerous mode of investigation where no other was available. The inner Arctic regions, which may be taken to embrace all that area of the Arctic Ocean north of the continental shelves of the surrounding continents, has for long defied penetration. Until near the end of the nineteenth century, many attempts had been made to force ships northwards into the pack-ice ; but all failed. Other attempts had taken the shape of sledging northwards over the ice from a base as far north as sea access allowed. These attempts were equally fruitless. While such attempts were laudable in an age when the outlines of the distribution of land in high latitudes were unknown, they were nearly always devoid of real scientific inspiration. The nineteenth century tended to measure the worth of exploration by the hardship and danger encountered rather than by additions to knowledge. Thus it substituted for the earlier centuries' motives of commercial gain an aim that was less material but not of higher benefit to man.

It was Nansen who in 1893 realized that to battle with the drifting pack was to play a losing game and that the only sensible course to pursue was to take advantage of its drift—not to move or try to move against the ice but with it. Thus he conceived and carried out his expedition in the *Fram*. On the results of this expedition are based by far the greater part of our knowledge of inner polar regions. Since then, no explorer has emulated Nansen. It is true that several explorers both by sledge and by air have reached or crossed the North Pole, but not one of them has made any considerable additions to our knowledge of high northern latitudes. Hurried journeys, especially at the speed of air travel, have not proved very valuable in scientific investigation. Even broad outlines of the lie of land may give an erroneous impression from the air, as the recent British Graham Land expedition has shown in correcting the aerial surveys of Sir H. Wilkins in the Antarctic. Ground work and sea work remain essential to serious exploration.

The Soviet authorities, in planning this recent expedition, followed Nansen's idea of using the drift of the ice, but by using air transport they were able to begin at the Pole instead of attempting to drift there. The Pole itself had no particular value as a starting-point, but some objective was necessary, and the Pole has a certain lure. The four members of the expedition had few duties to perform outside their scientific work : no energy was dissipated in difficult travelling. All their time was devoted to observation, and as a result we can look forward to a series of meteorological observations taken in high latitudes throughout some nine months. This in itself will be an invaluable contribution to the study of Arctic air currents and all that depends on them. In addition, the observers took regular soundings of the ocean, which will throw light on the position and extent of the submarine ridge which appears to connect Spitsbergen with northern Greenland and probably marks the line of Caledonian folds.

There should also be important observations in the winter phases of plankton and on the physics of the ocean water below the ice, such as the charting of the intermediate warm layer of Atlantic water and its relation to ice formation and wastage. The movements of the Soviet floe show a current from Siberia to Greenland, as indicated by the drift of the *Fram*, but as there was no tendency for the floe to be swept towards the north coast of Greenland the drift seems to lack the circulatory motion with which it was often associated. The rate of movement of the floe will determine the rate of the current and the rate of overflow of Arctic water to the Atlantic. All these and other observations, not to omit those on magnetism, will amplify the records of the *Fram*, which alone of previous expeditions threw light on these and cognate problems.

Men of science owe a debt of gratitude to these daring Soviet observers and also to the enterprise and sound organization of their rescuers. The Soviet Union has certainly shown extraordinary enterprise and insight in their exploration of Soviet and adjoining polar regions in recent years, and it is much to be hoped that the observations of the drifting station as well as those of the many Soviet observations on land in high latitudes will be readily and soon available to science.

Such a scale of investigation may be beyond the resources or perhaps one should say outside the conception of countries organized on different economic systems. Private enterprise in Great Britain has rarely shown great devotion to exploration without news value and has certainly been diffident about the publication of scientific results. One would like to note a greater tendency to appoint competent observers to the staffs of exploring expeditions. Such expeditions cost much and a great deal of that cost is unwisely spent if the sole results are to be the attainment of records. It is much to be hoped that the scientific side of expeditions, not only from Great Britain but also from other countries, will be strengthened in future along lines suggested by the Soviet Arctic Expedition, which has reached such a happy conclusion.

Lucretius

(1) Lucretius, Poet and Philosopher
By E. E. Sikes. Pp. ix + 187. (Cambridge: At the University Press, 1936.) 7*s*. 6*d*. net.

(2) Lucretius: De Rerum Natura
Translated by R. C. Trevelyan. Pp. xv + 295. (Cambridge: At the University Press, 1937.) 8*s*. 6*d*. net.

(1) IN view of the small compass of Mr. Sikes's book and the steadiness with which the author keeps his object before him throughout, it would be difficult to over-praise his achievement. It is certainly the best and most attractive presentation of the poet which we have in English, and, that being so, its small compass is a strong additional recommendation. Here we have the background and the spirit of Lucretius faithfully described, and in Mr. Trevelyan's book, which Cambridge has also lately published, we have the poems themselves excellently translated. Cambridge has done herself great credit and conferred a signal service on English scholarship and learning by these two works. But in the case of Mr. Sikes's book, 'learning' must be understood in the widest and wisest sense. He gives us not only a mature and well-balanced account of the poem of Lucretius in relation to Greek and Roman writers, but also he estimates—very judiciously on the whole—the origin, truth and permanence of the scientific moral and religious thought which it contains. This side of Lucretius will interest us most in these pages; it will probably always be regarded as the most abiding element in his work, however highly we may rate its poetic merits.

Our view, then, in this notice will be rather the converse of that which Macaulay is recorded to have expressed in the marginalia of the Lucretius which he read on his voyage to India. To him the poetry was often "neat and clear" and sometimes even "sublime beyond any passage of the kind in poetry". But the thoughts expressed were "drivelling", "wretched reasoning" or "contemptible nonsense". It would be strange if a writer, capable of the most sublime passages in poetry, were at the same time constantly falling into contemptible nonsense in his thought. The true judgment is much more balanced, though one might go a little farther than Mr. Sikes does in recognizing the "anticipatory" character of the scientific thought embodied in Lucretius. If, as Mr. Sikes admits, "the principles of Greek Atomism satisfied not only Gassendi but Newton", it is surely going too far to say, as he does in the next sentence, that to "look for anticipations of

the present day in the Democritean system is misleading". No doubt the modern thinker, with his trained power of observation and his elaborate machinery for measuring and recording results, stands in a quite different position from the old Greek with his unrivalled power of guessing. But the guess has its anticipatory value. The Greeks made men think and examine all the problems of the material world and life.

It is impossible to deny, and easy to underestimate, the intellectual stimulus of such pioneer work. Two great realms of the Epicurean thought, presented by Lucretius, stand out as examples of this, one in which we are now re-interpreting our definitions, another in which we have widely extended our field without disturbing the foundations on which it rests. The first is that conviction of a reign of law throughout the physical world on which the whole school of Democritus, Epicurus and Lucretius laid so much stress. It surely is not true, as Mr. Sikes suggests, that a quite different 'law'—of chance—has now taken the place of this belief in the uniformity of Nature. The law remains, and is in fact more universally observed than ever, as the basis both of our reasoning and our action. But, logically, we have been compelled to re-interpret it differently, by observing that when we reach a certain point in our examination of the infinitesimal, the law of uniformity escapes us and we are driven to take refuge in the idea of the levelling out of differences by a law of uniformity in the whole or the average. It is well known that Max Planck, to whom we owe the quantum theory, is himself one of the stoutest in re-affirming in a new sense the reign of law, and it is almost needless to add that no well-thought-out action, based on science, has been affected by the supposed vagaries of the infinitesimals of our thought.

On the other great department of Epicurean thought there is less to be said by way of re-interpretation, though much more by way of expansion and of deepening its import. This is given in Lucretius's first sketch of anthropology and of the progress of man from the savage to civilization. He is here, as elsewhere, building on the knowledge and thought of the Greeks, who for centuries had been open-minded and curious travellers in all the lands which surrounded them. He gives us at the end of his fifth book a well-knit summary of the result. There is, of course, no trace in it of any idea that man arose from a lower animal form. Lucretius will not hear of any mixed breeding between man and beast and, like a good rationalist, scoffs at the stories of the Centaurs. But on the subject of man's rise as man, he hits on the truth again and again with the insight of a poet enlightened by science. These five hundred lines are one of the marvels of literature and well repay repeated study. The origin of speech, its kinship with gesture, the discovery of fire from lightning, the birth of gods in dreams, the first working of metals, the development of the cultivation of the soil and the later blossoming of ships, laws, walled cities, pictures, statues and all the pleasures of civilization—these all find their place and they are explained much as our fuller knowledge of to-day would explain them. He actually winds up with the first known use of the word 'progress', as denoting the advance of the active mind of man.

It should be added that Mr. Sikes is at his best in appreciating the poetic worth and affiliations of his subject. Lucretius was no mere rhymester of a materialist philosophy but a great and moving poet, himself often moved by, and often using, the imaginative fictions which he would not admit as science. Virgil knew, studied and loved him. It was he in the "Georgics", "felix qui petuit rerum cognoscere causas", and to him may be applied in the fullest sense Longinus's definition of poetry, as amended by Matthew Arnold—"A great subject made great by the greatness of the poet's mind".

(2) It is in this spirit that Mr. R. C. Trevelyan has carried out his labour of more than twenty years in completing a verse translation of the "De Rerum Natura" and publishing it with a modest and most attractive introduction and an appendix by Mr. H. Sykes Davies on Macaulay's 'marginalia' to his copy of Lucretius. This has happily survived and makes most amusing reading. Macaulay evidently unburdened his philosophic soul by these solitary scribblings, much as the Kaiser Wilhelm did on his State-papers, though with less danger to the peace of society. They are very neatly summarized and countered in Mr. Sykes Davies's essay. It adds greatly to the interest of the volume, which will undoubtedly become the standard version of Lucretius in English.

No doubt there are some awkward lines, places where Mr. Sikes and others have done better than Mr. Trevelyan. But these are inevitable and quite subordinate to the general excellence of the whole. It reads as an original and is so readable that it should add many thousands to the number of those who know and appreciate the most remarkable literary relic of ancient Rome, one of the most remarkable of all antiquity.

In language, of course, Virgil is more finished, and for poetry, pathos and charm, much in Greek takes a higher place. But there is nothing in which are combined so much deep thought, argument, moving passages and stately diction—certainly in Latin, possibly even in Greek. As we have seen, it conquered even Macaulay's detestation of its philosophy, and he read it through three times in the course of four years. Nearly all the

great questions which have exercised the scientific mind in later times are here raised, often no doubt in a crude and dogmatic shape. But the argument carries one on, and Mr. Trevelyan's verses are clear and generally flowing. He uses the ten-syllabled blank verse as the most familiar of English verse-forms and also the most adaptable to expressing different shades of thought and feeling. Yet it must be said that Mr. Sikes, where he gives us some of his too rare versions of short passages, makes us wish very much for more. Here is Mr. Sikes's version of the most famous line in Lucretius:

"Such crimes could Superstition teach mankind."

That is certainly better, both for sense and sound, than Mr. Trevelyan's

"To such crimes
Religion has had power to persuade mankind."

But we are under a deep debt to them both.

F. S. MARVIN.

Entomo-Museology

Über entomologische Sammlungen (ein Beitrag zur Geschichte der Entomo-Museologie)
Von Walther Horn und Ilse Kahle. (Entomologische Beihefte aus Berlin-Dahlem, Bände 2, 3, 4). Teil 1. Pp. 160 + 16 plates. 15 gold marks. Teil 2. Pp. 161–296 + plates 17–26. 8 gold marks. Teil 3. Pp. 297–536 + plates 27–38. 10 gold marks. (Berlin: R. Friedlander und Sohn, 1935–1937).

THE completion of Dr. Walther Horn's account of entomological collections, entomologists and "entomo-museology" is a matter upon which to congratulate not only the author, but also that numerous race of museum entomologists who have already given it a hearty welcome. The work is, in fact, a revised and greatly expanded edition of the same author's "Über den Verbleib der Entomologischen Sammlungen der Welt" (Suppl. Entom., 1926 and 1929). Those combined papers occupied 182 pages; the present work fills 536 pages. A rough estimate shows that in this new volume some 6,600 entries occur, each giving a collector's name as fully as ascertainable and date of birth, and of death if not still living. This information is followed by a brief, sometimes almost laconic, statement as to the present whereabouts of the collections he formed. As those know who have had the pleasure of personal contact and correspondence with Dr. Horn, he is not only an indefatigable entomologist, but also a keen humorist; perhaps that is why he opens with "Å (Norwegian): see also under Aa"; "Aa" does not occur, except in Aall and in two "Aarons". Incidentally, the first correction in the supplement is "Å is to be deleted"—what a pity to spoil the joke.

The present whereabouts of the many collections to which Linnæus, Fabricius, Esper, Cramer and other early writers so often referred is a matter of keen concern to the serious student of systematic entomology, for without access to these it is frequently impossible to interpret many of these authors' descriptions—unless a guess can be called an interpretation. The information gathered together by Dr. Horn concerning these collections is extremely useful to his 'entomo-museologists'; the utility of some of the entries dealing with more recent collections, is, however, rather more debatable. For example, a statement that the collection of British insects formed by "Smith, H — J — (b —, d —)" was "sold at Stevens' by auction in 1872", to take an imaginary example, does not bear any clear evidence of being a fact of great scientific or even historical interest. But it is easy to criticize; far harder is it to draw the line in a compilation of this kind. In the entomological registers kept in the British Museum now for nearly a hundred years, there must be, at a chance computation, at least 50,000 entries of collections received. Should an abstract of these have been sent to Dr. Horn?

The body of the work is supported by thirty-six plates of reproductions of the handwriting, usually on a label, of a great number of well-known systematists. In museum work, the authenticity of a label is often of great importance; let us hope that these plates will help to solve many a puzzle—one scarcely dares suggest that some of the labels might conceivably have just the opposite effect! It is not until one has passed by all this, however, that the real personality of the author is discovered, for at the end of the work Dr. Horn has added a series of chapters in which he traces the evolution of museum entomology, with special reference, naturally, to Germany and Central Europe. The great names of the past, the old societies, the early publications are woven into a story of the beginnings of entomology such as only Dr. Horn could tell.

The mixture of foresight and fantasy in some of the early writings surely produced its finest blossoms (but no harvest) in Herbst, who in 1781 propounded a plan for the formation of a "German

Entomological Republic". Had the 'laws' of these 'republicans' been enforced, what an amount of labour would have been spared us; for example, descriptions were to be limited to *really* new species, had to be published in a single central journal, and be properly illustrated. One is tempted to quote much from this chapter on the old amateurs; but there is plenty of fun in the next one as well, for here Dr. Horn tells of the birth of the older national museums of Europe—London, St. Petersburg, Vienna, Paris and Berlin—and he is by no means complimentary (and justly so) about the Walkerian epoch of the British Museum. It is only in here that there does seem to be a lapse, for twenty-four pages of criticism of the reform proposals of Dr. Titschack seem rather out of place. Obviously this chapter and the next, which deals historically and discursively with the relation of systematic entomology to experimental zoology, are designed principally for internal consumption. "On lending specimens", is, however, sparkling and very personal; we should not like to incur Dr. Horn's wrath!

These later chapters bubble with facts and ideas, praise, blame and surprises—like Dr. Horn himself, full of the unexpected. Indeed, what better ending could he have chosen than the words he actually uses: "Was that not heroic?" Entomologists, especially those whose work lies in museums, will certainly answer 'yes'; but that is not what he meant.

N. D. RILEY.

A Biochemical Feast

Perspectives in Biochemistry:
Thirty-one Essays presented to Sir Frederick Gowland Hopkins by past and present Members of his Laboratory. Edited by Joseph Needham and David E. Green. Pp. ix + 362 + 6 plates. (Cambridge: At the University Press, 1937.) 15*s.* net.

A SHORT time ago, someone was happily inspired to suggest that a book of essays on modern biochemistry should be presented to Sir Frederick Gowland Hopkins to celebrate his seventy-fifth birthday. As the editors mention in their introduction, "It was felt that no greater tribute could be paid to the doyen of English biochemistry than a concerted creative effort by those who have had the privilege of his inspiration". No higher compliment could be paid to both the recipient and the gift than to suggest that each is worthy of the other.

Perhaps it would not be regarded as too frivolous if this book is likened to a sumptuous biochemical feast. Each dish on the menu has been prepared by a world-renowned chef, and all are gathered together to offer their own creations and masterpieces to a beloved master—the supreme chef who gave inspiration to so many of them. The organizers of this feast, Joseph Needham and David E. Green, have done their work extremely well, and the arrangement of dishes is excellent.

The first essay, "The Biochemistry of the Individual", by J. B. S. Haldane, certainly has the stimulating action of a cocktail, but in its sustaining and appetite-promoting properties it resembles more closely the *hors-d'œuvre*. After that, there is a long succession of nutritious dishes totalling thirty-one in all, and even the most critical epicure could find fault with very few of the items. Few will wish to partake of every dish, but every biochemist will find food and stimulation in plenty.

Passing now to the more usual form of review, the first point which is of special interest is that most of the authors have shown an eager desire to "indicate the most promising lines of advance" in the fields which they survey, and to speculate a little as to the future. The ordinary scientific publication is usually a very dull article, since it necessarily deals with facts and not fancy. Any tendency towards speculation or dreams, which may or may not be inspired, is ruthlessly dealt with by the editor and his blue pencil. In this book the authors have been given a free hand, and in most cases they have shown their appreciation of this liberty. In consequence the articles are interesting, illustrative and inspiring. No one could read the article by Raistrick, for example, without believing with the author that in the realms of microbiological chemistry "there is an almost inexhaustible field awaiting exploration", while on the other hand Haldane convinces us that it is probably a biochemist who will discover how to influence gene-reproduction in a definite direction.

In a book of this type the personal touch is so often evident; the suggestion that eleven genes may be controlling successive stages in the synthesis of chlorophyll "much as a team of well-controlled Ph.D. candidates would be in a certain type of German Laboratory", and the statement "This simple conclusion gave me the greatest mental satisfaction that I have experienced in my

life as a scientific worker. That is why I now offer it to Sir F. G. Hopkins" will perhaps suffice to indicate these features. Authors of scientific papers are usually compelled to write in the stilted third person and it is rather refreshing for once to meet with pronouns of the first person.

Without giving a list of the different chapters, it is almost impossible to indicate the immense field covered by the authors—again a tribute to the widespread interests of Sir Frederick Hopkins. Various aspects of protein chemistry are dealt with by Dorothy Jordan Lloyd, Peters and Luck; muscle by Bernal and Dorothy Moyle Needham; oxidation by Dixon, Krebs, Szent-Györgyi, and Green; vitamins and diet by Friedmann, Sir Edward Mellanby, and Harris; microbiological chemistry by Raistrick; calcium and blood coagulation by John Mellanby; molecular forces and surface films by Adam; biochemistry and mental disease by Quastel. Other articles discuss viruses, insect growth, hæmoglobin, drugs and mankind, and colour variation in flowers.

Sufficient has been said to show that in most cases the authors have consented to indulge in a little harmless but helpful speculation, and possibly because of this, these essays are of a very interesting nature. The articles by Sir Edward Mellanby, Raistrick and Wigglesworth might be quoted as typical examples of essays which will be read time and time again by many biochemists. The average biochemist should find interest and food for thought in at least nine-tenths of the articles. The majority may find one particular chapter rather indigestible, but there is adequate choice, and no one will be expected to assimilate and store the whole of the food provided. To sum up, it might be said that this book is one which every biochemist should buy, and decline to lend to his colleagues, for it is certain that the borrower would never return it. A. WORMALL.

Carl Friedrich Gauss

Carl Friedrich Gauss
Inaugural Lecture on Astronomy and Papers on the Foundations of Mathematics. Translated and edited by G. Waldo Dunnington. Pp. xi + 91. (Baton Rouge, La.: Louisiana State University Press, 1937). 1 dollar.

THIS monograph on Carl Friedrich Gauss, though short, has evidently necessitated a good deal of research, in the "Gauss Archive" at Göttingen, the Gauss Library, and elsewhere. The time of publication coincided with the celebrations arranged to mark the two-hundredth anniversary of the foundation of the University of Göttingen.

The book contains in the first place a sketch of the early life of Gauss from his birth (on April 30, 1777) down to 1803, which is a reproduction (with minor additions, changes and corrections) of an address given in 1933 before the Mathematical Association of America, Kansas Section; and this sketch the editor apparently hopes to expand into a complete biography in a later volume. The rest of the present volume is devoted to translations of two little-known papers by Gauss, with all necessary historical notes and references to the works quoted. The first (six pages only), recently discovered, seems to belong to the early years when Gauss was forced to think of becoming a teacher of mathematics; it is on the foundations of mathematics, and is not abstruse. The second is an inaugural lecture on astronomy, which may be the first of a series of lectures offered by him as his only course in 1808 when he lectured for the first time in Göttingen. It is, as the editor says, interesting in that it furnishes a clear picture of the development of astronomy up to the time of Gauss, and abounds in classical and historical allusions. In this lecture, Gauss quotes with admiration Schiller's charming poem "Archimedes und der Schüler."

The biographical sketch is well worth reading. It appears that two of Gauss's sons settled in the United States, and most of his descendants live there. To two of these, the late Mr. William T. Gauss and his daughter, the editor is indebted for much valuable information and source material. He has many references to Gauss's "Notizen-journal," or diary, the most important guide for dating *seriatim* his principal discoveries. He has also consulted the text-books used by Gauss and now in the Gauss Library, because Gauss was in the habit, all his life, of using the empty pages and the inside of the book-covers as writing-paper for entering not only formulæ and minor calculations but also, often, abstract researches.

A story on p. 36 illustrates Gauss's habit of self-assertion, verging at times on the inhuman. In thanking H. G. Grassmann for a copy of his "Ausdehnungslehre", he wrote that he found in it methods practically the same as those he had himself used for fifty years. Archimedes would not, one feels, in such a case, have written like that. T. L. H.

(1) The Observer's Book of Trees and Shrubs of the British Isles
Compiled by W. J. Stokoe. Pp. 240.

(2) The Observer's Book of British Butterflies
Compiled by W. J. Stokoe. Pp. 191.

(3) The Observer's Book of British Wild Flowers
Compiled by W. J. Stokoe. Pp. 224.

(4) The Observer's Book of British Birds
By S. Vere Benson. Pp. 223.

(The Observer's Pocket Series.) (London and New York: Frederick Warne and Co., Ltd.) 2*s.* 6*d.* net each.

UNLIKE many so-called books for the pocket, these handy volumes are only 5¼ in. × 3¼ in. and therefore actually will fit a coat or knapsack pocket with ease. From that point of view, and also that of a modest price, the books will prove a boon to those who are in the habit of going into the country on Nature rambles.

(1) 117 species of trees and shrubs are here described, and the text is illustrated by 177 photographs, line diagrams and coloured plates. Unless an inquirer is confronted with a garden escape or is examining some exotic cultivated species, it is scarcely likely that this useful volume will fail him.

(2) Every British butterfly appears to be included in this descriptive list to which reference is made easy by 154 illustrations, 68 of which are in colour. A résumé of the life-cycle of a butterfly and hints on collecting precede the actual detailed descriptions. To refer to this volume periodically, even if one is not fortunate enough to be able to go into the country for practical observation, will give endless pleasure and a good working knowledge of this group of insects.

(3) Though not so exhaustive, this volume will not fail the field naturalist except in very rare circumstances. Two hundred species of flowers are described and the text is illustrated by 120 line diagrams and 100 coloured pictures. The glossary might with advantage have been extended.

(4) 220 species of birds are here described. There are 200 illustrations, 100 of which are in colour. The author, who is honorary secretary of the Bird-Lovers' League, has spent many years in bird-protection work. His enthusiasm seems to have inspired this useful book, which in its turn should easily inspire readers to watch and study but not to destroy.

All four volumes are accurate and reliable—a credit to authors and publishers alike. They will make acceptable presents to Nature lovers and a source of inspiration and delight to hikers and ramblers.

Chlorkautschuk und die übrigen Halogenverbindungen des Kautschuks

Von Dr. Andreas Nielsen. (Chemie und Technik der Gegenwart, herausgegeben von Dr. H. Carlsohn, Band 16.) Pp. viii + 123. (Leipzig: S. Hirzel, 1937.) 6 gold marks.

RUBBER, owing to its unsaturation, is readily open to the formation of addition compounds, and it is somewhat surprising that investigation in this field was so long dormant. Apart from the addition reaction with oxygen—a perennial rubber problem in relation to ageing or perishing—the outstanding group of addition compounds is that formed with the halogens and halogen acids, of which the present book treats. Their relative importance can be judged by the 78 pages devoted to chlorinated rubber, the other seven compounds being dismissed in 26 pages of text.

Chlorinated rubber was first observed in 1835, but it is only in the last fifteen years that its commercial exploitation has expanded under the impulse of over-production of raw rubber and the organized search for "new uses". A large volume of literature has rapidly accumulated, however, partly on patents for the preparation and stabilization of chlor-rubber and partly on the application of the material in varnishes and lacquers, in which the author has had much experience. The present book is an excellent critical analysis of this scattered literature. Tested against the various controversies that the new industry has occasioned—such as, to depolymerize or not before chlorination, stability of chlor-rubber films against heat and water, adhesion of the films, suitable film vehicles—the book is always admirably lucid and balanced in its judgments. The wealth of precise detail in the sections on properties obviously contains much new and valuable work.

Rubber hydrochloride, which bids fair to become an important material for the production of transparent film, is adequately treated so far as existing, somewhat scanty information goes. The other chapters are only slight sketches.

The book is sufficiently indexed, and includes a comprehensive patent list. T. R. D.

Progress and Conquest

By S. Rivers-Smith and W. K. Spencer. (Simple Science in Simple English.) Book 1: The Creation and the World around Us. Pp. vii+100. 1*s.* Book 2: The Soil and the Plants. Pp. x+96. 1*s.* (London: Oxford University Press, 1937.)

THESE little books have been written to "realise the ideal whereby no child shall leave school without some knowledge of scientific principles". The language has been related by Dr. Lawrence Faucett to his 1,500-word vocabulary based on frequency principles, words outside that vocabulary being often illustrated by small sketches.

Book 1 is much the better of the two, and is difficult to praise too highly. Chapter iii, "Plans in Nature", introduces the idea of planning and the book is therefore especially significant. It is not true that "all living things come from eggs", but the chapter on "Living Things" is otherwise admirable.

Book 2 is similar in conception though there are some unhappy expressions. "Make or become liquid" is a poor equivalent for "dissolve". There is confusion about the purpose of pasteurization of milk: the tubercle bacillus is not a spore-former. The account of the value of humus is the most commendable feature in the book, which is worth buying for that alone. H. N.

The Physikalisch-Technische Reichsanstalt

Fifty Years of Progress

By a Correspondent

WHEN in the second half of last century the political and economic union of Germany had been effected, it was realized by far-seeing men that the new Reich could only maintain its position in the world, if the exact sciences, which had then reached a stage of development never before thought possible, were given adequate assistance by the State. In particular, there were many urgent physical problems, the solution of which was of the greatest importance for the general weal not only of Germany but also of the whole civilized world. This work could be undertaken only by a large State institute, in view of the considerable financial aid necessary to carry it out. For this reason, the Crown Prince Frederick, Werner v. Siemens, and Count Moltke took the matter up with the Government, and, in spite of much opposition, they obtained in 1886 the sanction of the Reichstag for the foundation of a "Physikalisch-Technischen Reichsanstalt" in Berlin-Charlottenburg. Hermann v. Helmholtz, the most famous physicist of his time, was appointed the first president of the new foundation, and took up his duties as director in 1887.

The institution was at that time unique, and had as its object primarily the development of the technique of accurate physical measurements, and the related establishment and control of the legal units of measurement, as well as the performance of tests submitted to it by industry. The uninitiated often regard measurements of precision as being opposed to the work of the discoverer, whose services they readily appreciate. Nevertheless, the successful activities of the discoverer would often have been frustrated but for the application of precision methods, as strikingly exemplified by Michelson's experiment, the discovery of the rare gases, the investigations on the effect of external fields on spectral lines, and the discovery of heavy hydrogen. Moreover, our belief in the trustworthiness of our conception of the atom is based essentially on the accuracy with which the fundamental constants involved have been determined by a variety of different methods.

The Reichsanstalt can look back with justifiable pride on having had on its staff men of science who, as a result of laborious and often inadequately acknowledged endeavour, have developed many important methods of measurement to an extraordinarily high level, or devised new ones. Of this we have ample testimony, for example, in the "Lehrbuch der praktischen Physik" of F. Kohlrausch, who was the second eminent president of the Reichsanstalt, which has been responsible for editing the book for many years, as well as in the "Elektrische Messtechnik" by that well-known investigator W. Jaeger. The Reichsanstalt has been responsible for the development of much of the standard equipment for measurements of precision which is used to-day throughout the civilized world. We need only mention here the Diesselhorst precision potentiometer, which is free from thermo-electric disturbances, the multiplex-interference spectroscope of Gehrcke and Lau, C. Müller's bolometer, and the Lummer and Brodhun photometer.

The precision methods of measurement were immediately applied to the establishment and control of the legal units in physics, which at the time of the foundation of the Reichsanstalt were subject to great uncertainty and lack of uniformity, a state of affairs equally intolerable to science and industry in all countries. The Reichsanstalt was concerned not only with the establishment of these units with the greatest possible accuracy, but also with their production in a form suitable for practical use. In other words, convenient secondary standards had to be derived from the primary standards. From among the relevant fundamental researches of the Reichsanstalt, which have extended over the whole field of physics, it will suffice if we direct attention here to only a few of them, such as the evaluation of the standard metre in terms of wave-lengths, the determination of the ohm and the related development of precision resistances of manganin, the researches on the standard cell (Weston cell), and those on the silver voltameter. Moreover, as a result of much laborious work, the temperature scale was fixed between the limits of $-259°$ and $+1773°$.

The precision methods devised for these purposes also opened up the way to the accurate determination of a number of fundamental constants that were not previously known with sufficient accuracy, such as the constants of radiation (Warburg, C. Müller), and the mechanical equivalent of heat (Jaeger and v. Steinwehr). We shall give only one example of the progressively increasing accuracy attained in measurements of this kind. Within the relatively short span of thirty years, it was possible to reduce the error in the measurement of the frequency of electro-magnetic waves from one per cent to one part in a hundred millions!

From the start, however, it was evident to German men of science that their work would have only a restricted value if they regarded it only as a service to their own nation and not as a cultural undertaking for the whole civilized world. For this reason they have always endeavoured to maintain a connexion with the advance of scientific work in other lands. Thus the Reichsanstalt has almost always been represented at the numerous international scientific conferences that have been held to fix and control physical and technical units of measurement, and its results have often had a decisive influence on the resolutions passed at these conferences. In particular, co-operation with the important foreign State institutes which have the same aims, for example, the National Physical Laboratory at Teddington, and the U.S. Bureau of Standards in Washington, has been so close that from time to time and also since the Great War representatives of the Reichsanstalt have worked in these other laboratories, and conversely. The importance of the guarantee of trustworthy international physical units is further exemplified by the fact that two presidents of the Reichsanstalt who were scientific men of world-wide repute, v. Helmholtz and Warburg, have taken part personally in international conferences dealing with these questions.

When we consider the enormous quantities of energy and material goods that are bought and sold in the world to-day, and that they are all measured in terms of these units, it is readily appreciated that this problem of units is of supreme importance not only from the scientific but also from the economic point of view. In these matters, insistence must be laid on the very accurate calibration of all measuring equipment. Thus it has been calculated that an error of only one per mille in the polarization apparatus used for the determination of the sugar content of beet would correspond at the present time, in Germany alone, to an annual market value of approximately one million Reichsmarks. Measuring equipment which has been tested at the Reichsanstalt in terms of its standards and by use of its precision methods is to be found all over the globe; and in the work of scientific investigators and technologists for the welfare of humanity, which cannot be too highly apprized, it has been of inestimable value. The continuously increasing range of the work of the Reichsanstalt is illustrated by the growth in the number of tests which have to be carried out by that institution. The present income from fees for tests undertaken is about twenty times that of the year 1890, and much more than double that for the year 1913.

The progressive rise in the demand for accuracy of measurement which has resulted from the work of the Reichsanstalt has necessarily also brought in its train advances in industrial development. Thus, as soon as it has been certified that the permissible limits of error of a measuring instrument have been reduced, it is incumbent upon industry to strive after increased accuracy in the manufacture of the instrument. This has been especially noticeable in the work of the optical industry.

Since the economic importance of its work in carrying out tests was obvious even to those not directly concerned with physics, the Reichsanstalt has as a rule been granted the requisite funds and equipment by the particular Ministry concerned. On the other hand, the accommodation, equipment and staff necessary for the prosecution of exhaustive and extended investigations in pure science before 1933 were far from adequate. Thus it can readily be appreciated that the development of the Reichsanstalt was determined primarily by its obligations in the matter of testing instruments and the like, whereas the scope of its purely scientific activities lagged behind. It is a great tribute to the idealism and deep-seated scientific enthusiasm of many men who have worked at the Reichsanstalt that, in spite of the obstacles already mentioned, many excellent investigations of the greatest value to pure science have been carried out within its walls.

Included among about 1,500 publications from the Reichsanstalt, with a total of some 18,000 pages, which have appeared since its foundation, there is a large number devoted to problems of pure science. In particular, it should be mentioned here that the important problem of the spectral distribution of intensity of a black body was completely solved experimentally by Lummer and Pringsheim at the Reichsanstalt. The investigations of Hagen and Rubens on the connexion between the electrical conductivity of metals and their optical properties in the infra-red region of the spectrum are outstandingly brilliant in their formulation and execution. They confirmed the existence of the relation between the reflective power and the conductivity of metals, which results from Maxwell's theory. It was at the Reichsanstalt that Goldstein discovered canal rays, and Gehrcke and Reichenheim the anode rays; here de Haas found experimentally the celebrated relation, fundamental in atomic theory, between mechanical and magnetic moments; and here Geiger presented atomic physicists with the point-counter, so indispensable in modern research. The list could be extended by further examples, but we have confined ourselves here to those discoveries from which we are already sufficiently far removed in time to be able to estimate their great influence upon physics.

Although it is often difficult to determine immediately the value for our future knowledge of physics of an investigation in pure science, this applies in still greater measure when we consider its significance for applied science or in the field of economics. Here things are not always so simple as in the discovery by E. Gumlich, who has worked in the Reichsanstalt since its foundation, that certain iron-silicon alloys have an extraordinarily small electrical conductivity and excellent magnetic properties. He immediately recognized the great importance of the diminution of eddy current losses, which depend on the conductivity, in sheet, used for the construction of transformers and dynamos. Gumlich's alloy sheet has found world-wide application, and it has been calculated that in Germany alone, by the use of the alloy sheet, industry saves in iron and electrical energy the equivalent of about one hundred million Reichsmarks a year.

Speaking generally, one can say that the statement made by Werner v. Siemens in 1884, in a memorandum urging the foundation of the Reichsanstalt, still holds good: "Almost without exception it is the result of new scientific discoveries, often with no apparent significance, that such new paths are opened up and important branches of industry newly created or revivified. Whether or not the recognition of a new scientific fact has a practical application cannot as a rule be determined until that fact has been systematically and completely investigated, that is, often after an appreciable lapse of time. For this reason, *scientific progress must not be made dependent on material interests*."

The Reichsanstalt has never lost sight of this point of view, and its researches were never linked up only with considerations of time, for the high scientific value of its work of standardization is also bound up with its research work. In order to appreciate the spirit that has always been cultivated in the Reichsanstalt, it will suffice to mention the names of its presidents, in chronological order: H. v. Helmholtz, F. Kohlrausch, E. Warburg, W. Nernst, F. Paschen, and J. Stark. As already mentioned, the Reichsanstalt had not long been completed (in 1897) before great difficulties had to be faced as a result of the lack of accommodation and funds, and these reacted on its scientific development, in spite of the eminence of those in charge. Thus between 1897 and 1933 the effective area of its buildings increased only by about 35 per cent, mainly due to the construction of a heavy current laboratory (1913) and of a low-temperature laboratory (1927), and the funds available to the Reichsanstalt for its work lagged far behind those which would have corresponded to the enormous development of physics in the same period. But the new National-Socialist Minister Rust, who has been in office since 1933, began immediately to try to improve these conditions, and his Ministry has succeeded in augmenting the available accommodation almost to double its earlier area, partly by renting suitable buildings, and partly by the acquisition of funds for the erection of new buildings, so that the number of laboratories of the Physikalisch-Technischen Reichsanstalt is now seventy-seven. This process of development is still being actively pursued, and Prof. Stark believes that the leaders of the National-Socialist State, recognizing the importance of the Reichsanstalt, will see to it that adequate financial aid is placed at its disposal, for without this the Reichsanstalt cannot fully realize its aims.

Apatite, Nepheline, and Rare-Earth Mining in the Kola Peninsula

PARTICIPANTS in the northern excursion of the seventeenth International Geological Congress in Russia were afforded ample facilities for inspecting recent mining developments in the Kola Peninsula, and especially the unique apatite deposits at Kirovsk. The latter occur within the world's largest known massif of nepheline-rocks, the Khibine Tundra*.

The Khibine massif (Umptek in the Loparian language) has an area of 1385 sq. km. It is of roughly circular outline, with a diameter of about 40 km. The neighbouring Lovozero massif to the east is similarly shaped, with diameter 25 km. and area 485 sq. km. Still farther east there occur great intrusions of alkaline granites, which occupy an area of 3700 sq. km.

The Khibine massif is of annular structure and may be regarded as a lopolith, with steep contacts cutting across Archæan gneisses and the Proterozoic Imandra-Varzuga series. A broad peripheral ring and the central area consist of coarse-grained nepheline-syenites. Along the annular break between these rings a series of younger fine-grained nepheline-syenites, and rocks of the ijolite-urtite range have been injected (see accompanying map). The apatite-nepheline injections which are mined occur as intercalations within the ijolite-urtite series.

*The Lapp word *tundra* means the barren uplands above the limits of tree growth, and not the flat, frozen Arctic swamp lands; hence the Khibine and Lovozero Tundras as names applied to mountain groups.

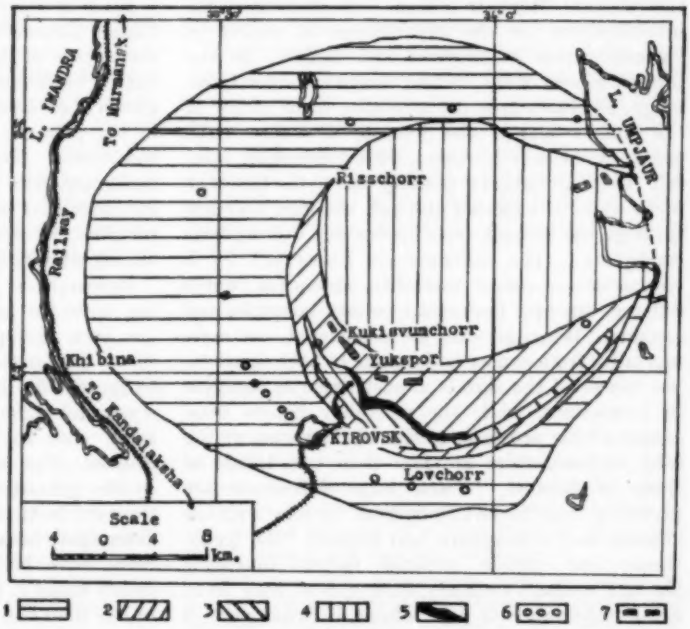
The less well-known Lovozero Tundra (Lujavrurt) is also built of successive intrusions of the same types of rocks, but it appears to be a horizontally stratified sill-like mass. Both massifs abound in complex zirconotitanosilicate minerals, and minerals containing rare earths as well as niobium and tantalum. As xenoliths of hornfels with imprints of Devonian plants have been found enclosed within the nepheline-syenite of Lovozero, its age is certainly post-Devonian. Radium determinations have shown that the absolute age of the Khibine massif is about 350 million years. Hence Russian geologists assign both intrusions to the period of Variscian diastrophism.

The apatite-nepheline rocks that form the basis of the mining industry are confined to the hanging wall of the ijolite-urtite ring. The ore body is divided into an upper zone consisting of up to 80 per cent apatite and 20 per cent nepheline (average P_2O_5 content, 30·8 per cent), and a lower zone with predominant nepheline (40–70 per cent), and P_2O_5 content ranging from 7 to 22 per cent.

The great new phosphate mine at Kirovsk, developed in eight years, is one of the industrial wonders of the world. This achievement is entirely due to Russian enterprise and energy. Owing to the close collaboration of seven organizations, the U.S.S.R. Academy of Sciences, the Arctic Institute, the Apatite Trust, the Scientific Institute of Fertilizers, the Central Geological and Prospecting Institute, the Rare Metals Trust, and the Leningrad Geological Trust, apatite is now being mined at the rate of 2 million tons per annum, and a reserve of 2,000 million tons has been established. The southern face of Kukisvumchorr Mountain has been blasted back into five broad ledges to a height of 1,500 feet. There are now more than twenty miles of underground galleries seven feet in height, electrically lit, and with electric haulage. A tunnel which admits the ordinary freight train has been driven to the heart of the mountain to facilitate loading. The social and industrial development of the region which, nine years ago, was a desolate arctic waste peopled by a few Lapp families, has kept pace with its scientific and technical investigation. The new town of Kirovsk with 40,000 inhabitants, and villages with the picturesque names of Nepheline and Apatite, have been built, and hundreds of miles of railway has been electrified.

Besides apatite, nepheline is mined for use in the ceramic industry and for its content of potash as fertilizer. The new mineral *lovchorrite*, a massive form of rincolite, chemically a fluorine-bearing titanosilicate of calcium, strontium and sodium, with up to 20 per cent of rare earths, is mined from pegmatites at the rate of several hundred tons a year. Another new mineral, *loparite* (titano-niobate of cerium, calcium and sodium) occurs in deposits of economic importance. Titanite (sphene) is also mined at the new Yukspor Mine, for what reason was not disclosed, but presumably for titanium, and possibly for its content of niobium and tantalum.

G. W. TYRRELL.



GEOLOGICAL MAP OF THE KHIBINE TUNDRA, KOLA PENINSULA.

1, KHIBINITE (VERY COARSE-GRAINED NEPHELINE-SYENITE); 2, NEPHELINE-SYENITES (FINE-GRAINED TYPES); 3, IJOLITES AND URTITES; 4, FOYAITE (COARSE-GRAINED NEPHELINE-SYENITE); 5, APATITE-NEPHELINE ROCKS; 6, OUTER ZONE OF RINCOLITE AND LOVCHORRITE DEPOSITS; 7, INNER ZONE OF RINCOLITE AND LOVCHORRITE DEPOSITS.

The chief sources of information are:

"Minerals of the Khibina and Lovozero Tundras" (English edition, abridged from the Russian monograph under the same title). U.S.S.R. Academy of Sciences, Moscow (see adv. in "Nature"); *Memoir of the Lomonossov Institute of the U.S.S.R. Academy of Sciences*, 1937. Pp. 152. Edited by A. E. Fersmann. Offices of the 17th International Geology Congress, Bolshaya, Ordynka, 32, Moscow 17.

"The Northern Excursion, Kola Peninsula", Guide-book, XVIIth International Geological Congress, Moscow, 1937. Pp. 119. Edited by A. A. Polkanov.

Recent Cancer Research

A SUMMARY of recent progress in cancer research is to be found in the fourteenth annual report of the British Empire Cancer Campaign and the thirty-fifth annual report of the Imperial Cancer Research Fund, which were published at the end of 1937. Work from widely distributed centres is described, and the two reports indicate the lines along which the problem of cancer is being attacked.

Dr. P. Stocks, the Medical Statistical Officer at the General Register Office, has continued his investigations on the distribution of cancer of various organs in England and Wales. In the present report of the British Empire Cancer Campaign, he shows how the mortality from cancer of the bladder and of the prostate increases, while cancer of the skin decreases, with diminishing rainfall. This correlation is possibly due to the fact that more water is excreted through the skin and less through the urinary tract under dry atmospheric conditions. The difference is illustrated by a comparison of cancer mortality figures for twelve different sites for Lancashire county boroughs and London. When all sites are considered, the male mortality from cancer is the same in both districts, yet cancer of the skin is almost twice as common in Lancashire, while the mortality figures from cancer of the prostate, of the bladder and of the lung in Lancashire are less than two thirds of those of London. These large differences are probably due to environmental factors such as climate and atmosphere, and support "the hypothesis that certain external factors operating through a man's ordinary environment may be of great importance in determining in what part of the body cancer will appear." The remarkable fact is that though such factors are operating in very different proportions, the same total cancer death rate is found in the different environments.

These findings are of interest from the point of view of factors affecting carcinogenesis which have been discussed by Prof. and Mrs. E. L. Kennaway (*Acta* of the International Union against Cancer, vol. 2, p. 101 ; 1937), who have collected evidence that most cases of cancer are probably due to several intrinsic or extrinsic factors. It is obvious that the differences in cancer mortality found by Dr. Stocks must be largely due to extrinsic factors. Analysis of mortality from cancer of the scrotum in different occupations and of mortality from cancer of the penis in Jews and non-Jews indicates that these forms of cancer are dependent on external factors.

In the report of the Imperial Cancer Research Fund, Prof. M. Greenwood briefly discusses the importance of statistics in assessing the social and economic factors of malignant diseases. He points out that mortality from diabetes is much lower and tuberculosis mortality is much higher among poorer people. Mortality from cancer is also relatively high among lower economic grades, but the differences are not so large as they are with diabetes and tuberculosis.

Much of the experimental work of the Imperial Cancer Research Fund has been concerned with the nature of those tumours which can be transmitted by filterable viruses. Dr. R. J. Ludford has grown fibroblasts and macrophages in tissue culture in the presence of the Rous virus. Under these conditions, fibroblasts were transformed into malignant cells while macrophages were not. This indicates that when infective filtrates of the Rous sarcoma are injected into fowls, the tumour arises among fibroblasts.

Research on the metabolism of tumour tissue has up to the present given interesting results but has been disappointing from a practical point of view. The metabolism of tumours does not appear to be specifically distinct from normal tissues. If some such difference could be found, it might give some clue to the chemotherapy of malignant disease. The carbohydrate metabolism, as shown by the quantitively large changes such as respiration and lactic acid formation, has been examined thoroughly because exact methods for its measurement have been worked out. Recent improvements make it possible to measure the respiration of less than one milligram of tissue. Tumours have a low respiration as compared with their lactic acid formation, but if the respiration were increased *in vivo* it is probable that the rate of growth would be increased rather than inhibited. It therefore appears that other biochemical processes must be investigated in the hope of finding some difference between malignant and normal tissue.

During the past year there has been an increase in the amount of work directed towards the treatment of cancer. The original observation of Dr. T. Reiter that electro-magnetic waves of between 3 and 4 metres wave-length are effective in destroying animal tumours has been confirmed by work carried out at Newcastle-on-Tyne. The action, however, appears to be due to the heating effect of the waves and there is no specific effect of any one wave-length. In order to ensure a cure, mouse

tumours must be heated at above 48° C. and rat tumours above 50° for 4 minutes.

The Report of the British Empire Cancer Campaign contains many accounts of clinical results obtained with radium and X-rays. During the year an apparatus has been constructed for the preparation of neutrons to be used to determine their biological effects.

Sir Edward Mellanby has shown that potassium permanganate and iodine destroy the virus of the Rous sarcoma *in vitro*. When iodine is injected into sarcoma-bearing fowls, however, the virus is not destroyed. Workers at Liverpool are still trying to find new lead compounds which will be effective against human cancer and can be safely administered. Researches carried out in the United States have shown that whereas injection of bacterial filtrates into animals with grafted tumours induces hæmorrhage and inhibits growth of these tumours, no such action occurs with spontaneous tumours. Recent experiments performed at the Royal Cancer Hospital show that colchicine, the alkaloid of the autumn crocus, behaves in a similar way to bacterial filtrates, showing the same difference in reaction between grafted and spontaneous tumours. These results indicate that chemo-therapeutical tests are probably best made on spontaneous tumours.

The finding of Dr. A. Haddow that carcinogenic compounds inhibit growth of animals and of tumours has been confirmed in other laboratories. During the past year it has been shown that carcinogenic compounds inhibit the growth of spontaneous tumours, and also that the growth of a tumour which has been induced by a carcinogenic compound may be inhibited by that same compound. If a carcinogenic compound is injected into an animal it disappears, and experiments suggest that the growth-inhibiting action remains when the greater part of the compound has disappeared from the body. Growth-inhibiting power has been found with some substances—for example, acenapthanthracene—which are apparently not carcinogenic.

Derivatives of carcinogenic hydrocarbons have now been prepared in which hydroxyl groups are present and these derivatives have not been found to be carcinogenic. It therefore appears probable that if a carcinogenic compound is abnormally produced in the body from a natural product such as a bile acid or sterol, then the hydroxyl group originally present in the natural product must be removed. E. B.

Obituary Notices

Prof. L. N. G. Filon, C.B.E., F.R.S.

ON December 29, 1937, the typhoid epidemic at Croydon claimed as a victim Prof. L. N. G. Filon, at the age of sixty-two years, when, in view of his robust frame and vigorous vitality, he might justifiably have been looking forward to many more years of the hard and unselfish work that characterized both his scientific and his public life. His friends had received encouraging news of his struggle against the disease, and the crisis was understood to be over, so that his death came as a shock for which they were ill prepared.

Filon was the son of M. Augustin Filon, the French critic and *littérateur*, who was tutor to the Prince Imperial. Throughout his life he showed a precision and fastidiousness in both the spoken and written word which was, no doubt, due to the atmosphere of his early upbringing, as was also his accomplishment in the French tongue. He started his academic life at University College, London, in 1894, where he had a brilliant career, culminating in the award of an 1851 Exhibition scholarship in 1898. It was at University College that he had his first experience of mathematical research, while acting as demonstrator to Prof. Karl Pearson, for whom Filon always expressed veneration, as witness his speech delivered at the dinner given in honour of Karl Pearson in 1934, when he said, "I had then just taken my degree, and K. P. had taken me upon his staff as Demonstrator, at what then seemed to me the princely salary of £40 a year. Nowadays young people expect at least £250 a year in the same circumstances, but then they do not get the stimulus of a Karl Pearson, which was worth more to me than the difference."

With the 1851 scholarship Filon proceeded to King's College, Cambridge, where he carried out extensive mathematical researches on the theory of elasticity, probably as a result of Karl Pearson's inspiration, since references to Todhunter and Pearson's "History of Elasticity" are frequent. The results are published in several lengthy papers in the *Philosophical Transactions of the Royal Society*. The theory of elasticity remained Filon's chief mathematical interest throughout life. At Cambridge, he also started his experimental work on the behaviour of light in transparent bodies subjected to stress, work which culminated in the standard book "Photo-Elasticity", published in 1931 in collaboration with Prof. E. G. Coker. This work enabled him to make brilliant practical use of that familiarity with the mathematics of stress-distribution which he so eminently possessed. By a foible such as often characterizes great men, Filon prided himself upon being an experimental physicist, although actually his experimental technique was not as highly developed as his mathematical powers.

In 1903 Filon was appointed lecturer in mathematics at University College, London, under the late Prof. M. J. M. Hill, and he became assistant professor of mathematics in 1906, a position in which he continued until 1912, when he succeeded Prof. Karl Pearson in the Goldsmid chair of applied mathematics and mechanics, tenable at University College. It was as a result of his teaching in the Department of Pure Mathematics that Filon produced his standard text-book on projective geometry, now in its fourth edition. He was elected a fellow of the Royal Society in 1910, and in 1935 a member of the Council and a vice-president of the Society, an honour which he much appreciated.

One of Filon's great interests was the University of London Officers' Training Corps, which, as Brevet-Colonel, he commanded from 1926 until 1932. He was already active in this connexion before the Great War, and he went on foreign service during 1914. He commanded the 2nd (Reserve) Battalion London Regiment from June 1915 until September 1916, after which his great technical abilities were more fitly utilized by his appointment to the technical staff of the Admiralty Air Service and of the Air Board.

After the War, Filon began to take an increased interest in the affairs of the University, as a result of which he was elected to the Senate in 1920, on which body he continued to serve until the time of his death. In all that had to do with University administration he showed the characteristic which, perhaps more than any other, distinguished his whole life—thoroughness. Needless to say, his unswerving devotion to what he considered right, and his lack of that praiseworthy pliancy and useful obliquity which adorn some of our leading administrators, occasionally led him to oppose certain notable personalities, but, in spite of this, his services were so outstanding that he was elected vice-chancellor of the University in 1933–35, the period during which the foundation stone of the candid and considerable —may we say elephantine—University building was laid. In spite of his activities in University administration, Filon still found time to produce research of outstanding merit, and to help his students to produce original work.

Throughout his academic life, Filon held that the chief duty of any member of a university staff was to impart learning. He was an excellent teacher and never spared himself, whether the class was large or small, elementary or advanced. He was particularly careful about the organization of exercise classes. One of his enthusiasms was astronomy, and the existence of the University of London Observatory is very largely due to his efforts. He had a deep knowledge of the early history of astronomy, and gave an excellent course on the subject. As a lecturer he had a clear and compelling style, and was well able to adapt himself to a general audience, when he lectured, as he occasionally did, on a general topic.

Filon was a man of wide culture, and one who believed profoundly in the dignity of the academic profession. A congenial companion and a warm-hearted friend, he occasionally indulged in short bursts of irascibility, which, if they arose suddenly, as suddenly subsided. These outbreaks, so well known to his friends, were purely superficial disturbances, for fundamentally Filon was one of the most generous and kindly of men, who would put himself to great trouble even for those who had small claims on him. Nobody could be a pleasanter speaker or a better host. The large numbers which assembled at the memorial service held on January 14 were not brought together by feelings of formal courtesy to a distinguished colleague but came to salute the passing of a great spirit and a great friend.

E. N. DA C. ANDRADE.

Major E. E. Austen, D.S.O.

THE name of E. E. Austen will live as that of a pioneer in the study of Diptera. Educated at Rugby and at the University of Heidelberg, he joined the staff of the British Museum in 1889 as the first curator to have sole and undivided charge of the collections of that order of insects. His first publication (January 1893) was upon a section of the family Syrphidæ (hover-flies), and his second (May 1895) upon the Œstrid genus *Cutiterebra* (American botflies parasitic upon rodents). Quite early in his official career, however, he must have realized that the great amount of undescribed material and the necessity for intensive study made the Diptera as a whole too wide a field for research, and, as at that time the importance of Diptera as vectors of disease was beginning to be understood, he wisely decided to restrict his researches mainly to blood-sucking flies and certain other groups of medical or veterinary importance. It therefore came about that the revision of the Syrphidæ which he had planned was never continued, though he retained his interest in the Œstridæ, publishing several papers on the family so recently as 1933–34.

Austen's interest in blood-sucking flies was doubtless cemented by a visit which he paid to Sierra Leone in 1899 in company with the late Sir Ronald (then Major) Ross, with the object of investigating the mosquitos of Freetown. This was the first expedition sent out by the Liverpool School of Tropical Medicine, and might well have led to his specializing on mosquitos, but he was called for service in the Boer War, and meanwhile the late F. V. Theobald was employed by the Museum to prepare a monograph of the Culicidæ. On his return from South Africa, Austen turned his attention to tsetse flies (*Glossina*) and horse-flies (Tabanidæ). His monograph of the genus *Glossina* (1903) was the first scientific revision of this group, later replaced (1911) by his more concise handbook. His numerous works on other blood-sucking flies include two separate volumes, "Illustrations of African Blood-sucking Flies" (1909) and "Illustrations of British Blood-sucking Flies" (1906), both long out of print, as well as many shorter papers descriptive mainly of African species. More widely known, perhaps, than any of his other publications was the Museum pamphlet which he compiled on "The House-fly as a Danger to Health", which had a very large sale and ran into several editions.

Apart from the expedition to Sierra Leone mentioned above, the only purely collecting trip which Austen made was in 1896, when he and the late F. O. Pickard Cambridge spent three months on the Amazon as naturalists on the cable ship *Faraday*. A greater opportunity for field work came to him during the Great War, when, after a period in France, in command of a company of the Artists' Rifles, he was transferred to the Egyptian Expeditionary Force for special duty in connexion with insect-born diseases. His work on mosquito and house-fly control earned him the D.S.O., and in spite of the arduous nature of this work he still found time and energy to make collections of other Diptera. Arrears of work, and later, official duties when he was appointed first deputy-keeper (1924) and then keeper (1927) of the Department of Entomology gave him little time for studying his Palestine collections. However, his retirement from the Museum staff in 1932 gave him more ample leisure and he turned with zest to the completion of a long-deferred labour of love and eventually (July 1937) produced a handsome volume on the Bombyliidæ of Palestine, which includes descriptions of the numerous species of this family collected by himself.

Austen's descriptive work, though sometimes criticized for a certain lack of conciseness in wording, embodied throughout three qualities upon which he always set a high value: accuracy, consistency and neatness. His neatness was exemplified in the wonderfully clear and firm handwriting, in which he took a just pride, and in the orderly arrangement of the collections under his charge. So precise indeed was this arrangement that visitors not infrequently remarked that the cabinet specimens were like well-trained regiments of soldiers on parade.

Although Austen's published work dealt almost exclusively with the groups of insects which were in his official charge, his interests were much wider. He preferred the Zoological Society to the Entomological Society on account of its wider outlook, and served on the publication committee of the former body. He was at one time vice-president of the Royal Society of Tropical Medicine and Hygiene, a member of the executive committees of the Imperial Institute of Entomology, the British Mosquito Control Institute, and the Society for the Preservation of the Fauna of the Empire. As a colleague he was loyal, purposeful, always anxious to increase the efficiency and prestige of his department, strongly resentful of injustice, and a strict disciplinarian. He was one of the small band to whom the present staff of the British Museum (Natural History) owes, almost entirely, the greatly improved conditions which the staff enjoys. Intensely patriotic, and with a very strong sense of the duty of a citizen, it is not surprising that he looked back with pride upon his service in the "C. I. V." and in the Great War, and that he took a keen and active interest in the local affairs of Northwood, where he had lived since 1913. Those who had the privilege of serving with him will always remember him, a man upright in body and mind, of sterling character, a manly man. N. D. R. and F. W. E.

Mr. J. L. Starkey

THE murder of Mr. J. L. Starkey, director of the Marston-Wellcome Archæological Expedition to the Near East, in Palestine on the evening of January 10, when he was on his way from his camp at Tell Duweir to Jerusalem to attend the opening ceremony of the new Palestine Archæological Museum on the following day, has deprived field archæology in the Near East of one of its most competent practitioners and exponents.

James Leslie Starkey was born on January 3, 1895, and received his training as a field archæologist under the British School of Archæology in Egypt. When in 1926 Sir Flinders Petrie, owing to the restrictions imposed on archæological excavation in Egypt, transferred his activities to Palestine, Mr. Starkey accompanied him and became his right-hand man. A succession of operations on sites in the neighbourhood of Gaza brought to light important evidence bearing on the periods of the Egyptian occupation, the Hyksos and the early Bronze and Stone Ages of Palestine. More especially significant, perhaps, was the varied evidence which pointed to Palestine having been a centre or gathering point in international relations. This work led Starkey to the excavation of Tell Duweir.

The systematic excavation of Tell Duweir began in 1932. Mr. Starkey, convinced of the importance of this extensive site for Palestinian prehistory by the evidence of surface finds, and more especially by the abundance of potsherds it showed, approached Sir Charles Marston, for whom Prof. John Garstang was then excavating the site of Jericho, and persuaded him to undertake its investigation, at first in co-operation with Mr. H. D. Colt, and afterwards with Sir Henry Wellcome and Sir Robert Mond. The first season's systematic excavation went far to substantiate, if indeed it did not quite fully confirm, his tentative conclusion that Tell Duweir, situated eighteen miles south-west of Jerusalem, rather than Tell el-Hesy, a site some ten miles away excavated many years before by Sir Flinders Petrie, was to be identified with the Biblical Lachish. The site was shown to have been in almost continuous occupation as a position of importance from the early Bronze Age down to the period of Persian occupation, while in the period of the Jewish kingdom when it was probably the centre of the defensive system of Palestine on this front, it had been sacked twice, inferentially by Sennacherib and Nebuchadnezzar—on the second occasion burned. The identification with the Biblical Lachish was borne out later by the discovery here of the famous Lachish letters, the earliest known personal documents in Hebrew, and the earliest example of Hebrew writing. Even more important in the history of written records are the inscribed ewer and copper dagger, on which a primitive form of alphabetic script is held by experts to be closely akin to the Sinaitic script discovered by Sir Flinders Petrie, antedating considerably the earliest known Phœnician alphabetic scripts, which possibly may be derived from it.

This brief notice of Mr. Starkey's work cannot close without reference to one instance of his flair

for the importance of a site, of which the full significance was not apparent until last year. This was his foresight in securing for the Marston-Wellcome Expedition the concession to excavate what has since come to be known as the "Bethlehem Bone Beds" (see NATURE, **140**, 431; 1937), in which have been found the fossil remains of numerous species previously unrecorded in Palestine, including the first specimen to be found in Palestine of the elephant and also of Hipparion, while fractured pebbles, found in 1937, but still *sub judice*, may turn out to be the first evidence of eolithic man in Palestine.

Mr. Starkey's interests were not confined to the past, and he had taken advantage of the opportunities afforded by the organization of his expedition to secure valuable photographic and other records of the people of Palestine of to-day. By the irony of circumstance, Mr. Starkey met his death at the hands of Arabs, although not only were his relations with his own Arab workmen of the most cordial character, but his scheme of excavation also made provision for ameliorating their condition by instituting cultivation plots on the site as the work proceeded.

WE regret to announce the following deaths:

Mr. W. H. B. Cameron, lecturer in physics in the University of Sheffield, known for his work in spectroscopy, on February 16, aged thirty-six years.

Dr. Ernest Goulding, formerly vice-principal of the Plant and Animal Products Department of the Imperial Institute, on February 15, aged sixty-eight years.

Prof. Gustav Jäger, emeritus professor of physics in the Technical High School, Vienna, on January 21, aged seventy-two years.

Prof. Anton Lampa, *Privatdozent* in physics in the University of Vienna, formerly professor in the German University, Prague, on January 26, aged seventy years.

Prof. H. E. Simpson, professor of geography and geology in the University of North Dakota, an authority on the geology of water supply, on January 31, aged sixty-three years.

Prof. H. W. Tyler, emeritus professor of mathematics in the Massachusetts Institute of Technology, secretary of the American Association of University Professors in 1916–33, on February 2, aged seventy-three years.

News and Views

Sir George Simpson, K.C.B., C.B.E., F.R.S.

THE directorship of the Meteorological Office of the Air Ministry of Great Britain is one of the country's most important scientific posts and the recent announcement that Sir George Simpson will retire in September will arouse wide interest and regret. He has had heavy responsibilities. When he assumed office in 1920, his first task was to weld into a coherent whole the very heterogeneous material that the Great War had left behind it, in such a way as to supply the needs of civil aviation, the Navy, the Army and the Air Force, as well as the general public. He shortly had to provide the information demanded by the ill-fated airship programme which came to an end with the *R*101 disaster: this involved a thorough investigation of air motion for use in airship construction and mooring, and an organization for providing route reports for airships in flight such as that which made possible the transatlantic flights of *R*100. Latterly, there has been the organization occasioned by the Air Force expansion and the air mail scheme: accordingly, there is now a section for synoptic work over the North Atlantic and another to give information for the flying boats to South Africa and the East during the first stages of their journeys. Happily, in meteorology, international co-operation is a vital necessity, involving a highly complex arrangement of codes for distributing weather data over the earth; here the British representative has played a very important part. With a fine record of scientific research, both experimental and theoretical, Sir George has shown that, as has often been urged in these pages, executive ability is not confined to those with a literary, political or other training. He is admirable in discussing a purely technical theme; but he is equally impressive in fighting a difficult case through a committee when ingenuity, tact and business capacity have full play; and his success would have been impossible without his obvious courage and sincerity.

Mr. N. K. Johnson

MR. N. K. JOHNSON of the Chemical Defence Research Department has been appointed to succeed Sir George Simpson. Mr. Johnson received his scientific training at the Imperial College of Science and Technology, South Kensington, choosing physics as the main subject for his honours degree. After a period of post-graduate work in astrophysics under Prof. A. Fowler, he went in 1913 to the Hill Observatory, Sidmouth, as assistant to Sir Norman Lockyer and Dr. W. J. S. Lockyer. Relinquishing this post, he served during the Great War in the Royal Air Force, and on the conclusion of hostilities was appointed professional assistant in the Meteorological Office. After a period of service at Shoeburyness, Mr. Johnson was seconded for duty under the War Office at the Experimental Station, Porton. Here he found full scope for his natural inclination towards experimental research work and he tackled with great success the new and difficult meteorological problems associated with chemical warfare. During this

period he designed the apparatus described in his well-known paper on "A Study of the Vertical Gradient of Temperature in the Atmosphere near the Ground" (London Met. Office, Geoph. Memoirs, No. 46, 1929). This work yielded much valuable information on the thermal structure of the lower layers of the atmosphere, and has formed the basis of similar work carried out afterwards in other parts of the world. In 1929, Mr. Johnson became Director of Experiments at the Porton Experimental Station, under the War Office, and was promoted later to his present post of Chief Superintendent, Chemical Defence Research Department.

George William Hill (1838-1914)

On March 3 occurs the centenary of the birth of the American astronomer, George William Hill, who, said Simon Newcomb, "will easily rank as the greatest master of mathematical astronomy during the last quarter of the nineteenth century". His father had emigrated to the United States in 1808 and Hill was born in New York, but his boyhood was passed in the country at West Nyack, N.Y., and there on his little farm he passed away on April 16, 1914, having received some of the highest honours science could bestow. Entering Rutgers College, New Jersey, at the age of seventeen years, he graduated in 1859 and then proceeded to Cambridge, Mass. Early in 1861 he was offered a post under Runkle, the superintendent of the American "Nautical Almanac", and he remained connected with the "Almanac" Office for more than thirty years. In 1877–78, there appeared his new method of dealing with the moon's motion, "his most original contribution to our knowledge of celestial mechanics", and about the same time under Newcomb he took up problems connected with Jupiter and Saturn, and at which he laboured for fifteen years. After the completion of this work he retired from the "Almanac" Office and settled again at West Nyack. "It is difficult," said one writer, "to find such another man as Hill in the whole history of Science. Although holding only a humble post in the 'Nautical Almanac' Office, he lived happily in the liberty it afforded him, and never sought to improve his material position. All he asked for was peace and freedom to prosecute his work". He received the Gold Medal of the Royal Astronomical Society in 1887 and the Copley Medal of the Royal Society in 1909, and France elected him a corresponding member of its Institute. His first paper was published in Runkle's *Mathematical Monthly*, just when he had graduated, and his last in the *Astronomical Journal* in January 1914, three months before he died.

Jacob Da Silva Solis-Cohen (1838-1927)

Dr. Jacob Da Silva Solis-Cohen, the founder of laryngology in the United States, was born in New York City on February 28, 1838, of distinguished Spanish and Portuguese ancestry. He received his medical education at Jefferson Medical College and the University of Pennsylvania where he qualified in 1860. After serving for a short time in the United States Army and Navy during the Civil War, he devoted himself to the study of laryngology. His first work on the subject, entitled "Inhalation in the Treatment of Disease", was published in 1867, and was followed in 1872 by his great work "Diseases of the Throat and Nasal Passages", which at once became a standard text-book and ranked with those of Morell Mackenzie (1860) and Francke F. Bosworth (1881) among the classics of laryngology. In 1874, appeared Solis-Cohen's monograph on "Croup in its Relations to Tracheotomy", based on the study of 5,000 recorded cases; in 1875 he published a book on "The Throat and Voice". In 1866, he was the first in the United States to institute regular lectures on laryngology at the Philadelphia School of Anatomy. In 1870 he was appointed lecturer on laryngoscopy and diseases of the throat and chest in the Jefferson Medical College and two years later professor of laryngology. He was one of the founders of the *Archives of Laryngology* and for many years edited the laryngological department of the *American Journal of the Medical Sciences*. He also helped to found the American Laryngological Association, of which he was the second president in 1880–82. As the result of his experience in the Civil War he excelled in the surgery of the upper air passages. In 1892 he was the first in America to perform a successful complete laryngectomy. His death occurred on December 22, 1927.

The Soviet Arctic Enterprise

The final stages in the rescue of M. Papanin and his three comrades began on February 16, when two planes from the *Murman* and *Taimyr* respectively landed on the drifting floe. It was decided, however, not to remove the men by air since they were in no immediate danger. During the next two days the *Taimyr*, guided by an aeroplane, fought her way through the pack-ice to the vicinity of the camp and on February 18, the four men Papanin, Krenkel, Shirshov and Federov, with all their records and equipment, were taken on board the ice-breakers. The drift had lasted for 258 days and covered about twelve hundred miles. The relief ships *Taimyr* and *Murman*, on emerging from the pack, set out for the port of Murmansk in northern Russia. Congratulations are to be extended to these four men of science and to their rescuers. It is expected that much of scientific importance will accrue from the data obtained at such great risk (see also p. 344 of this issue), and we look forward to the publication of the results when they have been finally worked out.

Pithecanthropus and Peking Man

Prof. F. Weidenreich, commenting in another column of this issue of Nature (see p. 378) on the recent discovery in Java of another skull and a fragment of jaw of *Pithecanthropus*, sets out the grounds for regarding the new evidence, not only as bringing a prolonged controversy to a sudden close, but also as confirming conclusively the close relation between *Pithecanthropus* and Peking man, which he had inferred from his study of the material previously known. From the time of the discovery by Dr.

E. Dubois in the early nineties of the last century of skeletal material in Java, to which he gave the title of *Pithecanthropus erectus*, there has been a division of opinion as to whether these remains were to be classified as human or anthropoid. Of recent years, opinion has tended in an increasing degree to incline to the latter; but recently doubt has been revived. Dr. E. Dubois, after prolonged study not only of the material known to anthropological text-books, the skull-cap, thigh bone and tooth from Trinil, but also of other material from the same provenance in his possession, for the most part not previously published, arrived at the conclusion, mainly on the evidence of the long bones, that we are here concerned with a gigantic gibbon. This conclusion, especially in view of the new material, has been received with respect, but not with general acceptance; and in the light of the new evidence it must be regarded as definitely disproved. *Pithecanthropus* now stands within the line of human descent, if only as a 'pre-hominid', a class in which Prof. Weidenreich would include him (or her) with *Sinanthropus*, Peking Man. It is interesting to note that Prof. Weidenreich's views as to the close relationship subsisting between *Pithecanthropus* and *Sinanthropus* are fully in accord with the recent conclusion of P. Teilhard de Chardin, who on the palæontological evidence holds that the flora and fauna of China in the early Quaternary period were derived at least in part from the south.

The National Fitness Campaign

AT a reception given by the City Corporation at Guildhall, London, on February 17, in support of the activities of the National Fitness Council, H.M. the King, replying to the Lord Mayor's address of welcome, said that the cause for which they were meeting is one of the first importance, for while we are striving to bring the fruits of education within the reach of all, and to improve the conditions in which everyone may grow and live, we must remember that our bodies are the instruments with which we have to work, and that they, too, need education. In order to become physically fit, all must have the opportunity for regular exercise, and this is what the National Fitness Council and its Area Committees are concerned to promote, and it will be their object to secure facilities for everyone, young and old, to follow his or her own inclination in the method of taking this exercise. The good will and co-operation of all who may be in a position to help being vital to its success, the King warmly commended the movement to leaders of industry and commerce, employers and employed, and to local authorities. In conclusion, addressing youth in particular, His Majesty said, "The future will be in your keeping. The present is your opportunity to fit yourselves for a full, active and therefore happy, life. The decision is left to your free choice. It is for you to make the effort."

British Industries Fair

THE British Industries Fair, 1938, opened on February 21 and will remain open each day until March 4 inclusive, except on Sunday, February 27. As in previous years, the Fair is divided between London and Birmingham. The London Section is held at Olympia and at Earls Court, the latter location taking the place of the White City, which was used last year and for many years before. Again it is to be noticed that only goods manufactured or produced mainly within the British Empire are permitted to be displayed. Among the trades exhibiting at Olympia we may note: chemicals (light and heavy), scientific instruments, photographic and cinematograph apparatus, radio apparatus and plastics, in addition to a large number of other industries usually classified as 'light' industries. At Earls Court, the main exhibits are those of the textile and furnishing trades and an Empire Section. Following the practice of previous years, the Engineering and Hardware Section is at Castle Bromwich, Birmingham. The exhibits here include farm and garden equipment, building materials and products connected with gas manufacture, utilization and distribution, electrical generation and transmission, transport and mining.

IT is interesting to notice that the total space occupied in London is more than 10,000 sq. ft. greater than that taken up for the 1937 Fair, and twenty of the trade sections exhibiting are larger than in 1937. At Birmingham, also, the area taken up by the exhibits is well in excess of the 1937 figure, which was a record. Some eight hundred exhibitors will be represented there, and it is stated that their stands are equivalent to a shop counter of British goods twenty-six miles in length. Holland, for the fourth year in succession, heads the list in the number of trade buyers who are visiting the Fair, Belgium being second, Germany third and France fourth. There is, of course, a large number of Empire buyers from overseas. In the Scientific and Optical Instruments Section at Olympia about twenty-six firms are exhibiting. This section of the Fair has grown considerably. Not many years ago, only a few firms exhibited and their stands were scattered indiscriminately. To-day this section occupies a prominent position in the main gangway, in which more than 5,500 sq. ft. are occupied in a combined display of all kinds of scientific apparatus. The instruments displayed include those used for research, medical, educational, industrial, and navigational (both marine and aerial) purposes. A review of the principal exhibits having scientific interest will be given in a future issue of NATURE.

The Proposed Thames Barrage

AT the meeting of the Metropolitan Water Board held on February 18 the report of the Works and Stores Committee on the proposal to construct a barrage across the River Thames at Woolwich came up for consideration. After relating the circumstances which have led to the institution of a public inquiry into the scheme by the Port of London Authority, the report pointed out that the Board's interests are materially involved in respect of the large filtration

works adjoining the Thames at Barn Elms and Barnes where there are, in addition to primary filters at Barn Elms, 5 and 19½ acres respectively of slow sand filters from which a total of 27–31 million gallons a day of filtered water is obtained. The top water level of these filter beds varies from 11 ft. to 16 ft. above Ordnance datum, while the bottoms of the filters lie between 4 ft. and 9 ft. below the same datum. Were the water in the Thames to be permanently impounded, as contemplated in the scheme, the level of the ground water would be raised to a height substantially above the floor level of the filter beds, and these would accordingly stand in a body of polluted water, a condition for which they were not designed, and would be beset with risks of contamination to the filtered water. Another danger would be the increased external pressure against the structures during the periods of evacuation for cleaning. The report went on to show that the reception into the river of sewage and storm water laden with sedimentary matter of a putrefactive and infective character within the limits of the impounded area, would induce in the summer season insanitary conditions, resulting in demands for the release of increasing volumes of water over Teddington Weir in order to abate the nuisance, and that this would jeopardize the integrity of the Metropolitan supply at a time of high water consumption. The report concluded with a strong recommendation to offer strenuous opposition to the scheme.

Galloway Hydro-electric Power Development

AT the Institution of Civil Engineers on February 22, a series of papers was read dealing with the inception and execution of the undertaking belonging to the Galloway Water Power Co., situated in the south-west of Scotland and occupying the southern portion of the mountainous region which lies between the estuaries of the Clyde and the Solway. The first paper by W. Hudson and J. K. Hunter gave an account of the initiatory stages and constructional details of the work. The area which has been developed includes the entire catchment (345 square miles) of the Galloway Dee, with, in addition, a further 50 square miles to the north-west, forming the catchment area of Loch Doon. With a slight exception, all the works lie on the greywacke formation, having a soft and shaly consistency. The climate is mild and the rainfall comparatively heavy, varying from 40 inches per annum on the coast to the south to more than 90 inches on the high ground between Loch Trool and Loch Doon. The more important works in their natural sequence consist of the Loch Doon storage reservoir, which provides main seasonal storage for the upper three power stations on the Dee, having an available capacity of 2,930 million cu. ft. and a total draw-down of 40 ft. The original level of the loch has been raised by 27 ft. Then come the Doon-Deugh tunnels by which water is drawn from the reservoir and discharged, as required, into the Dee. A series of three power stations have been installed at Kendoon, Carsfad and Earlstoun, normally operated together. A fourth station at Glenlee with a reservoir at Clatteringshaws Loch, and a fifth station at Tongland complete the chain of development. The paper by W. Hawthorne and F. H. Williams described the mechanical and electrical plant, consisting of eleven main generating sets with outputs of 6,000–12,000 kilowatts, the total rated capacity being 102,000 kilowatts and the voltage 11,000. The third paper, by H. W. Mountain, co-related the scheme with reference to the Grid, by which the bulk of the output is exported, half to central Scotland and half to north-west England. The total expenditure on the Galloway Development amounted approximately to £3,000,000 and the work was completed in the autumn of 1936.

Planning in a Democratic Government

IN an article, "The Place of 'Planning' in a Democratic Government", in the *Nineteenth Century* of December, Sir Daniel Hall discusses some of the reasons for the apparent inefficiency of democratic Government as compared with the efficiency of totalitarian States, and particularly with reference to the position of the technical expert in democratic administration. The problem of parliamentary Government, he suggests, is that of introducing planning into its administrative machinery to an extent which will permit a degree of foresight in the conduct of public affairs that will take long views, anticipate the effect of material progress on the social organism and concern itself with matters affecting the national welfare which have but little popular appeal. Sir Daniel Hall points out that the conception of planning has already entered our system to some extent, but our schemes are usually piecemeal and without provision for the consideration of their place in the national economy as a whole, while technical opinion is liable to be over-ruled and decisions determined less on intrinsic merits and informed criticism of proposals than by the volume of opposition aroused.

SIR DANIEL HALL considers that it is on this question of expert advice and authority that the British administrative system is weakest, although in recent years successive Governments have come to recognize the need for technical advice and established such bodies as the Development Commission, the Department of Scientific and Industrial Research and the Medical Research Council. These bodies and particularly the Economic Advisory Council provide the nucleus of an organization which could exercise the function of planning within the ordinary machinery of Government, and Sir Daniel Hall suggests that the Economic Advisory Council should be replaced by a Planning Council with a strengthened personnel and a technical staff, linked with the Research Councils. The Planning Council would remain an advisory body with the immediate function of advising the Cabinet or the departments on any question submitted to it. Its most important function, however, would be its initiative in planning, and its constitution would afford men eminent in the industrial, commercial, financial and scientific world opportunity of putting

forward their ideas, obtaining criticism from their fellows in all walks of life and collecting the relevant data before formulating a plan of action. Its deliberations would be almost wholly concerned with matters upon which the modern developments of science have a bearing, but it would possess no power of action nor publicity. None the less, Sir Daniel Hall suggests that in this way those responsible for government would be supplied with the services of the expert in a way comparable with that in which Fascist and Communist Governments are served.

Scientific Study of Foreign Policy

THE report on the work of the Intellectual Co-operation Organization submitted by the Sixth Committee to the Assembly of the League of Nations refers to the way in which the scientific study of problems of foreign policy is obtaining recognition as a new branch of learning. The International Studies Conference has devoted two years to the preparation of the study of peaceful change, and as a result of research in many countries a series of works on demographic problems, the distribution of raw materials and colonial questions which would offer reliable contributions to the solution of such problems is about to be published by the Institute of Intellectual Co-operation. The next two years are to be devoted to the study of economic policies in relation to world peace. An international conference on higher education held at the Institute dealt with such problems as the organization of various university faculties, scientific research and higher technical education, overcrowding in the universities and international collaboration. A Permanent Committee on Higher Education was appointed by the Conference to keep in touch with these questions. The report directs special attention to the programme of activities drawn up by the Intellectual Co-operation Organization and the Executive Committee of the International Council of Scientific Unions, which is directly connected with the advancement of all branches of science. The Organisation has also been requested to consider what steps might be taken to enable writers to continue to carry out their work with full freedom of thought and expression and a guarantee of material security. Reference is made to an international inquiry into the reorganization of secondary education, the key to the problem of overcrowding in the universities and liberal professions, and finally the report outlines a draft Act to set up and maintain National Committees on Intellectual Co-operation and to grant financial contributions to the International Institute of Intellectual Co-operation.

Automatic Control for Aircraft

ANOTHER step towards the elimination of the physical and nervous strain upon the pilot in a long flight, caused by his having to maintain continuous manual control over the machine, has just been accomplished by the linking up of several separate devices into one synchronized piece of apparatus for use in such cases. A De Havilland "Dragon" passenger aircraft has been acquired by Messrs. Air Travel and Survey, of Sydney, for photographic survey work. The technique of this demands that the machine must fly on a dead straight line and a level keel for periods, and an automatic pilot that can control this while the crew attend to other photographic duties has been in existence for some time. This apparatus in its latest form, known as a 'deviator', keeps the machine on a given course, but the direction of this must be controlled by the pilot. The new apparatus adds to this a Marconi Wireless 'homing' device which sets the aircraft's course in the direction of the transmitting station, when tuned in to that wave-length. The station would normally be an aerodrome with a special call sign, but ordinary broadcasting stations may be used, provided that the pilot can identify them. He thus has nothing to do except to watch and adjust the wireless receiving apparatus as necessary. This machine was successfully demonstrated on February 17 at Croydon. It brings within sight the day when the pilot of a big aircraft will merely have to exercise a general watch over the instruments in his cabin, more comparable with the manner in which the captain of a ship controls his craft.

Radio Research in India

REFERENCE has been made from time to time in the columns of NATURE to the desirability of encouraging the carrying out in India of fundamental radio research of the type sponsored by the Radio Research Board in Great Britain. This matter was referred to in the presidential address prepared by the late Lord Rutherford for the recent Silver Jubilee meeting of the Indian Science Congress. It was pointed out that the investigations conducted in Great Britain on the propagation of radio waves over great distances have considerably increased our knowledge of the upper atmosphere. The details of the electrified regions of the atmosphere vary considerably with the hour of the day and with the season of the year as well as with geographical location. The results are of great practical importance in the selection of the most suitable wave-lengths for radio communication, and, in addition, it does not seem impossible that such studies may prove of value in long-range weather forecasting. There appears, therefore, to be scope for research on this matter in a wide field and in various parts of the world, and Lord Rutherford expressed the hope that it will be vigorously pursued in India. Reference was made to the very promising beginning that has already been effected by Profs. S. K. Mitra and M. N. Saha and their students in attacking fundamental radio problems. As an instance of the important work which is in progress in other parts of the Empire, mention was made of the admirable progress made in this field by the Australian Radio Research Board, which was established nearly ten years ago.

Research in Foot-and-Mouth Disease

THE Minister of Agriculture and Fisheries has decided to enlarge the Foot-and-Mouth Disease Research Committee. The scope of the problem

under investigation has become wider than was envisaged when the work was begun fourteen years ago. There is increasing evidence of the necessity for pursuing the intensive study of this particular member of a group of diseases affecting human beings, animals, and plants in close relationship with investigations into virus diseases generally, and of enlisting the experience of workers in other fields of virus research in the elucidation of the problems connected with foot-and-mouth disease. It has been decided in the circumstances that it would be an advantage if the Agricultural Research Council and the Medical Research Council were more actively and directly associated with the work of the committee than at present, and the following have therefore been appointed additional members: Prof. S. P. Bedson, professor of bacteriology in the London Hospital Medical College; Prof. T. Dalling, professor of animal pathology in the University and director of the Animal Diseases Research Institute, Cambridge; Major G. W. Dunkin, director of the Agricultural Research Council Field Station; Mr. G. M. Findlay of the Wellcome Bureau of Scientific Research; Prof. H. B. Maitland, professor of bacteriology in the University of Manchester; Prof. F. C. Minett, director of the Research Institute in Animal Pathology, Royal Veterinary College, and Mr. J. Henderson Smith, head of the Department of Mycology, Rothamsted Experimental Station.

Fire at the Lister Institute, Elstree

A FIRE occurred in the chemical laboratories of the Serum Department of the Lister Institute, Elstree, on February 21; the cause was the explosion of an acetone-distilling apparatus. The chemical laboratories, dark room, and balance room were completely destroyed, but the adjoining bacteriological laboratories and cold-storage rooms, together with valuable stocks of antitoxins, therapeutic sera, vaccine lymph, and a considerable amount of experimental material were saved through the prompt and efficient work of the staff at Elstree and the local fire brigades. The chemical laboratories were a recent addition to a block of buildings erected by the Institute in 1903 when the Serum Department was under the direction of the late Prof. George Dean. These were afterwards occupied by Mr. Sydney Rowland whilst he was carrying out research for the Indian Plague Commission.

Control of Vehicles in Streets by Traffic Signals

A PAPER on street traffic signals by F. G. Tyack was read to the Institution of Electrical Engineers on November 4. The descriptions and illustrations given show that modern street traffic signal equipment bears a remarkable similarity to telephone exchange equipment. It is proved that where complex switching is required, electrical switching telephone apparatus with its ready adaptability forms an ideal solution. Apart from the contribution of the telephone industry, which applies principally to the controllers, other branches of the electrical industry, such as supply lamps, cables and rotating machines, are represented in the necessary equipment. The earliest road signals were manually operated and the mechanically controlled 'fixed time' signal came next. This type consists of a mechanism arranged to measure off arbitrarily determined 'go' and 'stop' periods. Fixed time signals was a cheap method of solving the problem of accident prevention. They are found unsuitable when the traffic is variable, as they cause unnecessary delays and bring automatic signals into disrepute. The logical solution of the problem is that the signals must be operated by the vehicles themselves. The top of a rubber mat projects slightly above the road level. As the channels in the mat are depressed by the wheels of a vehicle, miniature bellows in the contact box become inflated and an electrical contact is made. Impulses indicating the speeds of the vehicles are thus transmitted to the controller. A further step in advance is to have a master controller which, in conjunction with a traffic 'integrator', adjusts the speed of the signal indications to suit the particular traffic density at the time.

Leyden University Botanical Gardens

THE 350th anniversary of the foundation of the Leyden University Botanical Garden has recently been celebrated. It is the oldest botanical garden in Europe after that of the Vatican (1447), Leipzig (1542), Pisa (1543), Padua (1545), Florence (1546) and Bologna (1567). Only the Gardens of Leyden and Padua have remained in the same place since their foundation. The first catalogue of the Leyden Garden drawn up by Clusen in 1594 contained more than a thousand species of plants, and in the time of Boerhaave this number had risen to 5,800. Numerous Japanese plants were added to the Garden by von Siebold in the nineteenth century.

Medical Research in Canada

THE conference on the organization of medical research which was held in Ottawa on February 18, and was attended by the Governor-General, has resulted in the formation of a National Medical Research Committee for Canada with five members, who have power to nominate ten others. The chairman is Sir Frederick Banting, professor of medical research in the University of Toronto, and the other members are Major-General A. G. L. Macnaughton, president of the National Research Council; Dr. R. E. Wodehouse, the Deputy Minister of Health and Pensions; Dr. T. H. Leggett, president of the Canadian Medical Association; and Dr. G. S. Young, president of the Royal College of Physicians and Surgeons of Canada.

The Night Sky in March

THE date of the Spring Equinox is March $21^d\ 7^h$ U.T. The moon is new on March 2 at $5{\cdot}7^h$, and on March 31 at $18{\cdot}9^h$; full moon occurs on March 16 at $5{\cdot}3^h$. Lunar conjunctions with the planets occur as follows: on March $4^d\ 6^h$ with Saturn; on March $5^d\ 15^h$ with Mars; on March $28^d\ 7^h$ with Jupiter. On March $18^d\ 0^h$ Venus and Saturn are in conjunction; on March $20^d\ 5^h$ Mercury and Venus, and on March

28d 22h Mars and Uranus. The occasion of the fairly close proximity of Uranus to Mars may be used for locating the latter with binoculars, the magnitude of Uranus being about 6·0 and that of Mars about 1·5. Mars sets at 21·7h. Mercury is at greatest eastern elongation on April 2, so that towards the end of March there is a chance of seeing this elusive planet in the evening twilight. Venus is likewise an evening star, but sets less than one hour after the sun until the latter part of March. Saturn is passing out of view as an evening star and is in conjunction with the sun on March 29, but Jupiter now rises in the early dawn as a bright star of magnitude −1·6. In the late evening in the middle of March, the bright stars of Orion and Sirius and Procyon are being lost to view towards the west, but there are compensations. For a small telescope, the double star, Castor, is an excellent subject for observation. γ Virginis is another well-known binary the period of which is about 180 years. 12 Lyncis (R.A. 6h 39m, Dec. 59° 31′ N). and 11 Monocerotis (R.A. 6h 25m, Dec. 7° 0′ S.) are both triple stars. There is a stellar cluster, Messier 35, north-preceding η Geminorum, and the cluster Messier 44, better known as Præsepe, south-preceding γ Cancri. Away from the obscuration effects of the Milky Way, remote space can be explored with powerful photographic telescopes. In Leo, there is a remarkable group of extra-galactic nebulæ (*NGC* 3185, 3187, 3190 and 3193) exhibiting a variety of types and at a distance of about 7½ million light years from the earth. Another group in Boötes and one in Ursa Major (overhead about midnight in the middle of March) give Doppler displacements in the spectra of the component nebulæ equivalent to recessional velocities of about one-seventh the velocity of light itself; the inferred distances are of the order 230 to 240 millions of light years.

Announcements

DR. ANTOINE LACASSAGNE has been nominated director of the Paris Radium Institute in succession to Prof. Claude Regaud.

THE International Conference of Naval Architects and Marine Engineers will be held in London on June 16–18. Further information can be obtained from Mr. P. W. Thomas, 39 Elmbank Crescent, Glasgow.

DR. G. W. TYRRELL gave an address before the Royal Society of Edinburgh on February 7, on the seventeenth International Geological Congress held in Moscow in 1937, in which he described the Congress meetings, at which 72 per cent of the 422 papers presented were by Russian authors and dealt with Russian geological topics. Excursions to the Kola Peninsula and Karelia, and to the Urals and western Siberia, were then described, and the almost illimitable mineral wealth of the U.S.S.R. illustrated (see also p. 354 of this issue).

THE Bureau of the United States Census has recently issued a survey of deaths from motor-vehicle accidents in 1937 showing that in 128 major cities of the United States there were 9,964 deaths in 1937 as compared to the 9,308 in 1936—an increase of 7 per cent. Most of the cases occurred in the first six months of the year. 66 cities showed an increase, 57 a decrease and 5 had the same number of deaths as in the previous year.

A SCIENTIFIC BOOK CLUB has been formed to enable the inquiring layman to keep abreast of the latest developments in modern science and to build up a first-class library of scientific books at a considerably reduced price. Each month the Scientific Book Club brings to its members a recently published book which is of outstanding scientific importance. The books are not confined to any particular publisher but are chosen strictly on merit from the various publishing houses, thus ensuring the widest possible field for selection. Further information can be obtained from the Secretary, Scientific Book Club, 121 Charing Cross Road, London, W.C.2.

IN view of the great interest aroused by the National Institute of Industrial Psychology's report No. 7 ("Improving the Blackboard", by W. Douglas Seymour), the Institute has decided to hold a small exhibition of suitable primrose-coloured boards of different materials and of the chalks for use with them. The exhibition, which is non-commercial in character, will be held at the Institute, Aldwych House, London, W.C.2, during the fortnight beginning February 28. From Monday until Friday in both weeks it will open at 9.30 a.m. and close at 5.30 p.m. except on March 1 and 8, when it will close at 1 p.m.

THE British Non-Ferrous Metals Research Association, in co-operation with the Swedenborg Society, will shortly publish a translation of Swedenborg's famous treatise on copper, "De Cupro", originally published in Latin in 1734. No translation has hitherto appeared. This book gives an account of the smelting and refining of copper as practised in many countries at the time; the production of brass; the nature of copper ores and their assaying; and various other matters pertaining to the properties of copper, its alloys, and its history. Communications on the subject should be addressed to the British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, London, N.W.1.

THE Trustees of the Lady Tata Memorial Fund invite applications for grants and scholarships, in the academic year beginning on October 1, for research in diseases of the blood, with special reference to leukæmia. Grants of variable amount are made for research expenses or to provide scientific assistants to senior workers. Scholarships are awarded as personal remuneration; their value will not ordinarily exceed £400 per annum for whole-time research, with proportionate adjustment for work on a part-time basis where this is approved. The grants and scholarships are open to workers of any nationality. Applications must be submitted before March 31, 1938, and the awards will be made in June. Further particulars and forms of application may be obtained from the Secretary of the Scientific Advisory Committee, 138 Bedford Court Mansions, London, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 375.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Structure of Metals

IN a recent note with the above title[1], Dr. A. Müller has described interesting effects which are observed when metals are investigated at high dispersion with X-rays. When X-rays fall upon a stationary specimen of metal, and are reflected back through nearly 180°, the reflection from the individual crystal grains appears as a number of distinct spots. If the specimen is rotated during the exposure, smooth Debye-Scherrer lines appear, the centres of which are accurately measurable (in precision measurements of spacing the specimen is always rotated for this reason). In referring to the distinct spots he obtains with the stationary specimen, Dr. Müller says, "the surprising fact is that they are scattered over a comparatively wide range . . . thus indicating lattice variations in the individual crystals of the order of 1/1000–1/2000."

If this deduction were right, it would be rather disturbing, since the accurate estimation of lattice spacing, which is so important a feature in X-ray technique, would appear to be meaningless, or at any rate would only represent a statistical average. We think it possible, however, that Dr. Müller's results may be explained by the optical considerations which are described below; this possibility in any event should be fully explored before adopting the rather revolutionary conception of wide variations in spacing as a general feature of the crystalline grains.

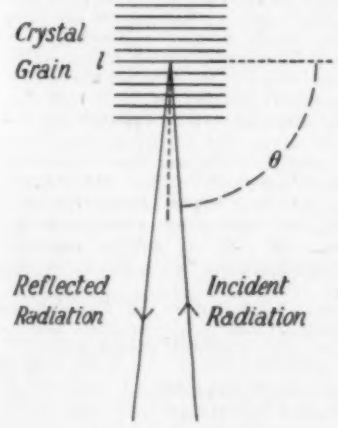


Fig. 1.

Consider a crystalline grain, shown in Fig. 1, which for simplicity we suppose to have equal width and depth l. X-ray 'reflection' takes place over an angular range on either side of the mean glancing angle θ_0, which is nearly 90°; the smaller the crystal the wider is this range. The intensity of the diffracted

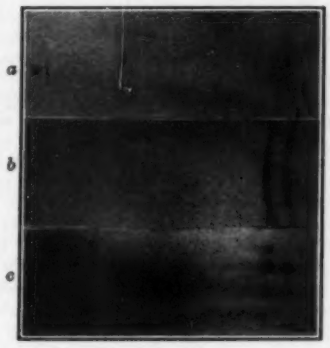


Fig. 2.

radiation at an angle $\theta_0+d\theta$ is governed by the product of two factors which represent:

(*a*) *The interference between beams coming from successive crystalline planes.* The total range $\delta\theta$ between zero values of the factor on either side is given by

$$\delta\theta = 2\lambda/l \cos\theta.$$

(*b*) *The diffraction of radiation after specular reflection at each crystal plane.* Its angular spread is similar to that of waves passing through a slit of width l sin θ, and the range is given by

$$\Delta\theta = 2\lambda/l \sin\theta.$$

A. H. Compton pointed out in 1922[2], that when $\theta_0 < \pi/4$, $\delta\theta$ is the smaller, and defines the sharpness of a diffracted beam, whereas when $\theta_0 > \pi/4$, it is $\Delta\theta$ which is the smaller. In Dr. Müller's experiment, where $\theta_0 = 85\frac{1}{2}°$, $\Delta\theta$ is about ten times as narrow as $\delta\theta$.

To see what this means, we may imagine the crystal grain to be rotated through a small arc (of the order of a degree). In any one position it gives a narrow spot of width $\Delta\theta$. This spot appears as the crystal rotates over the whole range $\delta\theta$, being strongest at the centre of the range. Alternatively, if the specimen is stationary, individual grains give sharp spots, which are staggered throughout the range $\delta\theta$ as determined by (*a*) above, although the grains have identical lattice spacings.

It is easy to test this explanation by giving the specimen a 'micro-rotation' over a small angle. The spot due to each crystalline grain is then drawn out into a smear having an intense centre, and fading

away on either side. If the grains have different lattice spacings as Müller suggests, the maxima of these smears should be staggered. If, on the other hand, they have the same spacing, the maxima should all fall into place below each other.

Fig. 2 shows the result of such a micro-rotation. The same specimen (a copper wire) was used for all three photographs, the lines being the K_α doublet of cobalt radiation, reflected in the 400 order ($\theta \sim 82°$ for α_1, 83° for α_2). Fig. 2*a* shows the spots produced by individual grains when the specimen is stationary, and it is indeed surprising how much the spots are staggered. Fig. 2*b* shows the ordinary Debye-Scherrer lines when the specimen is completely rotated so that numerous grains pass through the reflecting positions. Fig. 2*c* shows the effect of extending spots similar to those of Fig. 2*a* into smears by a rotation of 3°. It will be seen that their maxima appear in the same positions as the lines in Fig. 2*b*; in other words, the *crystal grains have identical spacings*.

Two suggestions may be offered to explain the striking spread of the spots in a case such as that of Fig. 2*a*. In the first place, though the smooth α doublet lines of Fig. 2*b* appear to be well resolved, examination with a microphotometer shows that they are actually so wide that they overlap, showing that $\delta\theta$ is greater than the separation of α_1 and α_2. Thus there may be a complete overlap of the spots due to α_1 and α_2 when the crystal is stationary.

In the second place, if the incident radiation is not monochromatized, Laue spots due to white radiation appear all over the film. Some of these spots may be near the K_α lines, and seem to belong to them, thus increasing the apparent spread.

We wish to stress, however, that it is still an open question whether all the features of Dr. Müller's photographs can be explained in this way; further investigation is required.

Dr. Müller's experiment suggests an elegant way of examining individual crystal grains, for we gain more information about their dimensions from the individual smears of Fig. 2*c* than from the complete rotation illustrated in Fig. 2*b*, which merely gives the average size.

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Jan. 17.

[1] NATURE, **140**, 1012 (Dec. 11, 1937).
[2] Compton, A. H., *Phys. Rev.*, **19**, 69 (1922).

Cooling Curves and the Laws of Radiation

I WISH to record a method of treating the radiation between a body and a surrounding enclosure which has been applied to the study of the heating and cooling curve techniques so much used by metallurgists, and may have other uses.

If the time-temperature relationship of such a body is obtained from the Stefan-Boltzmann law, the resultant expression and equations derived from it, if the case is even slightly complicated, are too difficult to be handled by workers of ordinary mathematical attainments. The use of Newton's law of cooling gives simpler expressions, but leaves an uncertainty as to their validity, particularly for theoretical work. By equating a Newtonian expression of radiation such as $k(T-T_e)$ to the corresponding Stefan expression, the 'constant' may be evaluated; and it is found that in many interesting cases the approximation $k = 4C\sigma T_g^3$ (where C is the area-emissivity coefficient between body and enclosure, σ is the absolute emissivity of a black body, and T_g is a fixed temperature chosen by rules which are often very simple) is a very good one, and that equations based on it are easy to handle. For the case of a thermally simple body in an enclosure the temperature of which is a linear function of time, for example, there is, when t is large, an important temperature difference between specimen and furnace (unsuspected or ignored by many previous workers) given by $\rho = -\dfrac{ms}{4C\sigma T_g^3}\cdot\dfrac{dT_e}{dt}$ and the temperature difference at all values of t is given by $\dfrac{\varphi-\rho}{\varphi_0-\rho_0} = e^{-4C\sigma T_g^3 t/ms}$ where s is specific heat of the specimen, and φ is $T - T_e$.

This manageable form can be modified to allow for heat transfer other than by radiation, and permits, among other things, the existing thermal curve techniques to be examined in a critical manner. In the course of this it was found that if the enclosure temperature as well as the temperature of the specimen were observed, these techniques would be improved in that certain difficulties of interpretation would be removed, and enriched in that the heat quantities involved in a physical change could be assessed and curves of dH/dT (H is the heat contents of the specimen) obtained, not in many cases with the accuracy of Sykes's method[1], but with complication and labour little greater than that of an ordinary thermal curve, and with the ability to work with both rising and falling temperatures.

Two techniques so suggested appear particularly promising. The first is a modified inverse rate curve method. The values of $\delta t/\delta T$ usually observed, when multiplied by the appropriate values of φ, enable a curve of relative dH/dT to be plotted, and absolute values may be obtained if a suitable constant or constants are determined. Mr. W. S. Walker, formerly demonstrator here, has during the last three years developed the practical side of this method and used it to measure the heat changes in carbon steels over the allotropic range, but publication is delayed owing to an unforeseen experimental error. The second technique involves the concurrent plotting of $T-t$ and T_e-t curves by a semi-automatic device permitting a very open scale to be used. The taking of these curves should be less mentally exacting than obtaining a high-grade inverse-rate curve; they will be fairly sensitive and very easy to interpret, and curves of dH/dT are obtainable by measuring areas between the pair of curves. Mr. E. A. Fowler, assistant lecturer here, is collaborating with me in developing this method.

A critical examination of Plato's[2] and Rosenhain's[3] heat evaluation techniques has been made, and it is hoped to publish this shortly.

C. HANDFORD.

Metallurgical Laboratories,
College of Technology,
Manchester.
Jan. 26.

[1] Sykes, C., *Proc. Roy. Soc.*, A, **148**, 422 (1935).
[2] Plato, *Z. phys. Chem.*, **55**, 721 (1906); **58**, 350 (1907); **63**, 447 (1908).
[3] Rosenhain, W., *Proc. Phys. Soc.*, **21**, 180 (1908).

Stimulation of Paramagnetic Absorption by a Constant Field

In previous researches[1] it has been found that paramagnetic absorption at frequencies of about 2×10^7 may decrease considerably under the simultaneous application of a constant magnetic field. We have now observed that, on the contrary, paramagnetic absorption may be strongly stimulated by a comparatively large constant field applied parallel to an alternating field of comparatively low frequency. The accuracy of our observations did not allow us to detect the dissipation of heat in iron alum at a frequency of $3\cdot7\times10^6$ and a temperature of 77° K. in the absence of a constant field. But under the influence of such a field a strong absorption appeared which attained a maximum at 1,000 oersteds and decreased in still larger fields. The maximum shifts to larger fields for higher temperatures and lower frequencies.

These results are in agreement with our recent observations[2] on paramagnetic dispersion in the same region of frequencies and temperatures, which had already indicated that the absorption region shifted enormously (from about 10^9 to 10^6) under the influence of a strong parallel field. Further, the conclusion[3] that the phenomena at a fixed temperature and field cannot be described by one single relaxation time is corroborated by these results.

Details will be published in *Physica*.

F. Brons.
Natuurkundig Laboratorium, C. J. Gorter.
Rijks-Universiteit,
Groningen. Jan. 20.

[1] Gorter, C. J., *Physica*, **3**, 503 (1936); **3**, 1006 (1936).
[2] Gorter, C. J., and Brons, F., *Physica*, **4**, 579 (1937). Brons, F., and Gorter, C. J., *Physica*, **5**, 60 (1938).
[3] Kronig, R. de L., *Physica*, in the press.

A Wireless Interferometer

In a recent communication in Nature[1], the use of a pair of spaced frame aerials for locating the position of the scattering clouds in the *E* layer of the ionosphere was described. The system, an example of which is shown in the accompanying illustration, has another function, which is also of importance in the investigation of scattering, namely, the determination of the spread in direction of the scattered rays.

In the presence of a single ray, the E.M.F.'s in the two aerials are definitely related in phase and amplitude, and so it is possible by varying these quantities in the central circuit completely to balance the output of the system. When, however, there are many rays of random direction and phase forming a spread pencil or cone of independent rays, the setting for any one ray differs from that of the others, and all the rays cannot be balanced simultaneously. It is no longer possible to obtain a complete balance since the E.M.F.'s in the two aerials are not exactly correlated. There is a certain random diversity effect which increases as the frames are spaced farther apart. It is possible to calculate the degree of correlation between the E.M.F.'s in the two aerials when it is assumed that the E.M.F. arises from rays of random phase and direction within a cone of angular aperture φ_0, the distribution being

$$A\epsilon^{-\varphi^2/\varphi_0^2}$$

. The correlation coefficient r is then approximately $r = 1 - \left(\frac{2\pi d}{\lambda}\frac{\varphi_0}{2}\right)^2$, so long as $\left(\frac{2\pi d}{\lambda}\frac{\varphi_0}{2}\right) \ll 1$.

Photo] [*Marconi's Wireless Telegraph Co. Ltd.*

With such a correlation coefficient, it is also possible to calculate the ratio of the residual E.M.F. at the best obtainable balance to the E.M.F. of one aerial alone. This ratio is

$$\frac{u}{v} = \frac{2\pi d}{\lambda}\frac{\varphi_0}{\sqrt{2}}$$

and becomes unity, that is, there is no effective balance at all, when $\pi d\varphi_0/\lambda = 1/\sqrt{2}$.

It will be observed that except for a numerical factor of the order of unity depending on the distribution function of intensity within the pencil of rays, this is exactly the Michelson interferometer formula relating the angular diameter φ_0 of a pencil of rays to the observed mirror spacing d at which the contrast ratio in the fringes disappears. Thus the pair of spaced frames constitutes a wireless Michelson interferometer, the frames taking the place of the mirrors and the ratio u/v corresponding to the fringe intensity ratio.

In the radio technique, the spacing is left constant but the contrast ratio measured. In the astronomical technique, the distance d is varied until the contrast ratio is unity. The same quantity, namely, the angular spread, is, however, measured in both cases.

Observations have been made during the past year to measure the angular spread of the rays reflected from the ionosphere.

Two salient facts emerge: The first is, that whereas for local ground signals balances, that is u/v ratios, of 1/1,000 or less can be obtained, it is very rare for a reflected signal from the ionosphere to give a better balance than about 1/30, with 20-m. frame spacing, and the balance is usually of the order of 1/10, giving a spread of the order of 1° or 2°. The second is that the behaviour of the short scattered echoes (from heights of 100 km.) is in complete contrast with

that of the normal echoes from the *E* or *F* layer (indicating a completely different mechanism of reflection). Whereas the latter all give a quite well-defined balance, it is almost impossible with 20 m. spacing to find any balance at all on the former, except on rare occasions. With 6 m. aerial spacing, the balance is broad and ill-defined, with a minimum-maximum ratio of ½ to ¼ implying angular spreads of the order of 30°. Thus the spaced aerial system, used first as a direction indicator and secondly as an interferometer, indicates, in both cases, that the sporadic short-scatter reflections are of an entirely different character from the normal *E* and *F* reflections. Both the results imply that the sporadic echoes are not reflected from a uniform *E* layer, but from high density patches in the *E* region, which are irregularly distributed both in time and in space.

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Jan. 20.

[1] NATURE, **140**, 846 (Nov. 13, 1937).

Spectrum of Chromium Chloride, CrCl

RECENTLY Mesnage[1] has reported a system of bands, degraded to the red, in the region 2600–2650 A. He obtained the bands by an electrodeless high-frequency discharge through a heated quartz tube containing chromium chloride. We have noticed that the wave-lengths recorded agree very closely with those of the known system of aluminium chloride. The wave-lengths given by Mesnage, with their vibrational quantum numbers, are reproduced beside those for the corresponding aluminium chloride bands as observed by Bhaduri and Fowler[2]; the intensities given are those for AlCl, Mesnage not having recorded any intensities for the bands which he observed.

CrCl (Mesnage)		AlCl (Bhaduri and Fowler)	
λ	v′,v″	λ	Int.
2638·1	2,4	2638·10	3
2632·9	1,3	2632·80	3
2629·8	0,2	—	
2627·0	1,2	2627·00	3
2623·5	3,2	2623·54	5
2622·3	0,1	2622·40	4
2619·9	1,1	2619·98	4
2618·1	2,1	2618·21	3
2614·3	0,0	2614·44	8
2612·0	1,0	—	
2610·3	2,0	2610·22	6

It will be seen that all except two of the eleven bands agree to within 0·14 A. Of the AlCl bands, all the strongest of those which are degraded to the red are included in the above list; the AlCl bands degraded to shorter wave-lengths in the same region do not appear to have been observed. Jevons[3] has commented on the occurrence of AlCl bands when using aluminium electrodes in discharge tubes, and the bands appear to be of frequent occurrence as an impurity, but it is not easy to see how the bands could arise in an electrodeless discharge, unless perhaps the chromium chloride picked up a chip from the mortar when it was pulverized. In the absence of published photographs of Mesnage's bands, or any estimates of their intensities, it is difficult to be quite certain of the identity of the two systems, but the agreement seems to be much too close to be entirely fortuitous.

The vibrational analysis proposed by Mesnage gives the vibrational constants $\omega_{1/2}'$ and $\omega_{1/2}''$ for the upper and lower electronic states of CrCl as about 33 cm.$^{-1}$ and 117 cm.$^{-1}$ respectively. These values are in any event surprisingly small and can scarcely be correct; judging by the values of these constants for other chlorides, we should expect values of the order 300–400 cm.$^{-1}$ for CrCl.

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[1] Mesnage, P., *C.R. Acad. Sci.*, **201**, 389 (1935).
[2] Bhaduri, B. N., and Fowler, A., *Proc. Roy. Soc.*, A, **145**, 321 (1934).
[3] Jevons, W., *Proc. Phys. Soc.*, **48**, 563 (1936).

Lecture-Room Demonstration of Electron-Optical Crystal Patterns

AN electron-optical image of the crystalline pattern of a metal surface in a sealed-off cathode-ray tube was obtained by Schenk[1] for nickel, cæsium metal serving as activator. The optimum of emission was obtained at a temperature of about 500° C.

Some time ago, we succeeded in obtaining similar results for nickel, nickel iron and iron, using strontium and barium as activator. Metallic strips of the first-mentioned metals were mounted as cathodes in vacuum tubes of similar type to that already described[2], in which a tungsten spiral covered with a suspension of strontium carbonate in amyl acetate and a barium evaporator[3] were mounted.

After evacuation and while the tube was still connected with the pumps, the cathode was heated to a fairly high temperature, then strontium (probably together with strontium oxide) was deposited on it by heating the tungsten spiral. Afterwards a quantity of barium was evaporated in order to absorb the gas residue. Although by this procedure the main part of the evaporated barium was deposited on the wall of the tube, part of it was deposited on the cathode, the latter thus being probably activated by both strontium and barium. Finally the tubes were sealed off.

With an 'electron-microscope' of this type (using a magnetic focusing coil as described elsewhere), intensive emission patterns could be obtained after a (not always identical) heat treatment of the cathode. With nickel and nickel-iron, the intensity of the emission after suitable activation at a temperature of the cathode of about 700°–800° C. was such that the fluorescent pattern could be projected optically on a screen (for example, 50 cm. × 50 cm.), thus giving rise to a highly magnified image of the crystal pattern of the metal surface, visible in a lecture-room[4].

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Eindhoven. Jan. 7.

[1] Schenk, D., *Z. Phys.*, **98**, 753 (1935).
[2] Burgers, W. G., and Ploos van Amstel, J. J. A., *Physica*, **4**, 5, 15 (1937); J.A.T.M., London Congress (1937), p. 82.
[3] See Burgers, W. G., and Ploos van Amstel, J. J. A., *Physica*, **3**, 1057 (1936). Kemmnitz, G., Knoll, M., and Walcher, W., *Z. Phys.*, **96**, 612 (1935).
[4] Cf. Burgers, W. G., *Z. Metallk.*, **29**, 250 (1937).

Seismic Waves in the Core of the Earth

THE velocity of longitudinal waves in the earth increases with depth down to the core, at a depth of about 2,900 km., where there is a discontinuous drop from 13·7 km. to about 8 km. per sec. Within the core, the velocity has usually been calculated as increasing gradually to about 11·5 km. per sec. at the centre.

This velocity distribution leads to a well-known focusing effect for longitudinal waves which have passed through both mantle and core (P' waves), at about 142° from the epicentre. The interval between this focus and the last arrival of direct longitudinal waves through the mantle (P), at about 105°, should be a shadow zone. The P waves are known to continue into this interval by diffraction around the core. Apparently, the P' waves also extend backward into the shadow zone from 142° to about 110°. These observations have been referred to diffracted P' waves, although the process of such a diffraction is very obscure. The large amplitudes of these waves, especially about 122° and 111°, strongly suggest that another explanation is needed. Supposing that these are also direct waves through the core, we find that all observed travel times and amplitudes are consistent with a velocity in the core increasing from 8 km./sec. at its surface (depth 2,900 km.) to about 10·2 km./sec. at 4,850 km., where a rapid but probably continuous increase takes place, the velocity reaching 11·4 km. per sec. at 5,150 km., then decreasing very slowly to 11·3 km./sec. in the central part of the core.

This velocity distribution requires two additional reversals in the travel time curve, which accounts for various peculiarities in the observations of P' near the focal distance (which remains unchanged at 142°). It also accounts for similar observations of other waves, such as SKP and $P'P'$.

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Effect of Veiling Glare on Apparent Size and Distance

THE effects of the veiling glare due to illuminated fog may be imitated by reflecting diffused light into the eye from a piece of plate-glass at 45° to the line of vision. The intensity of the glare may be varied readily, but remains unchanged relatively for objects seen at different distances through the glass plate. In this it differs essentially from the glare of fog, which may be greater for distant than for near objects.

The relative apparent sizes of two similar disks seen at different distances in normal vision do not depend simply on the inverse square law, but on the index of 'phenomenal regression'[1] peculiar to each individual subject of the experiment. When two such disks, or other objects, are seen through a veiling glare, the 'articulation' of the visual field is reduced by the glare, and the influence of distance cues is cut out to some extent. We have found, in an experiment done at the University of Glasgow, that, when glare is present, the relative apparent sizes of similar disks at different distances approximate to the sizes expected on the inverse square law. As the glare increases, this approximation increases too, until, with monocular vision and glare such that all distance cues are cut out, it is very close indeed. Glare appears to be the only factor which has such a marked effect on phenomenal regression. With monocular vision under fullest glare, however, one subject out of seven saw the distant disk the same size as the near disk when the near disk was about three times the diameter expected on the inverse square law—even larger than in binocular vision without glare.

The full report on this experiment will be published in the *British Journal of Psychology*, but we should like to point out that it is of great interest in relation to the problems of vision under fog and glare conditions in everyday life. It should be possible to get a more satisfactory imitation of fog glare by an apparatus in which differential glare could be made for the objects of which the sizes or distances are compared. The problems centre around apparent distance as well as apparent size. It is well known that in fog objects seem unexpectedly large, and this is believed to be due partly to the increase in their apparent distance. Artists habitually avoid showing detail in objects which are to seem distant, and the increase in apparent distance of objects seen in fog is partly due to the blurring of detail and partly to the reduction of distance cues in the surrounding visual field. Experiments could be devised in which apparent distance varies, and in which the objects compared have some visible structure which would be blurred by the glare.

Only one subject out of seven who did the experiment at Glasgow confirmed, under the conditions of that particular experiment, the common observation that distant objects look large in fog, and, in general, the results indicate that great individual differences are to be expected. Individual differences in phenomenal regression probably affect the relative accuracy of different people in comparison of sizes, distances and speeds under normal conditions, but it is likely that the man with the highest phenomenal regression will be most disturbed by fog.

These and other points could be investigated experimentally, and might be of great interest in relation to the problems of the control of motor-vehicles, aeroplanes, ships, and also of the accuracy of aiming and shooting, under glare, fog, or in twilight vision.

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Jan. 10.

[1] Thouless, R. H., "Phenomenal Regression to the Real Object" *Brit. J. Psych.*, **21**, 339–359; **22**, 1–30 (1931).

Structure of Chromosomes

PROF. RUGGLES GATES has published photographs of chromosomes at mitosis in *Trillium sessile* by Mr. Mensinkai, which he states show a double coiled structure of chromatids[1]. It happens that structures of this kind have also been obtained in the John Innes laboratory in root tip preparations of the same species and are described in an article by my colleague Mr. La Cour and me in a paper now in the press[2].

It is generally recognized that the fixative employed may influence the products of fixation

observed in the cell. Our paper deals with the comparative effects of various fixatives in current use, and we found that the appearance of two threads was an artefact induced by the fixative and due to bubbles of different refractive index in the chromatid. In our experiments these were shown clearly when a fixative containing a high proportion of acetic acid (alcohol acetic, Flemming with acetic) was used. They were practically absent when the acetic was omitted in Flemming solution. Prof. Gates does not state what fixative was employed by Mr. Mensinkai. It will be seen in Mr. Mensinkai's photographs (as in the accompanying figure) that the bubbles are of different sizes, and the single line may be broken by two lying side by side. This would imply, in parts at all events, a triple thread. Prof. Gates concludes that the chromatid is double or even quadruple; is he prepared to admit that it may be triple? Until Prof. Gates can establish the fact that the structures observed by Mr. Mensinkai are real properties of the chromatid itself and not effects induced by the fixation, it would be idle for me to discuss their problematical bearing upon my hypotheses of chromosome structure and the relation of meiosis to mitosis.

Trillium sessile, ROOT TIP SMEAR FIXED MEDIUM FLEMMING + ACETIC, STAINED FEULGEN. × c. 1600.

Prof. Gates also rejects specifically the evidence of X-ray changes in the chromosomes. The genetical experiments on these lines by Morgan and his collaborators[3] and the cytological experiments by Riley[4] and Mather[5] have not to my knowledge been disputed by anyone but Prof. Gates. Elsewhere[6], Prof. Gates has similarly rejected the evidence of the chromomere at meiosis and in the salivary glands of Diptera. If the observations of Belling and Belar and of Heitz and Painter are thus disposed of, I am content that my views should place me rejected in their company.

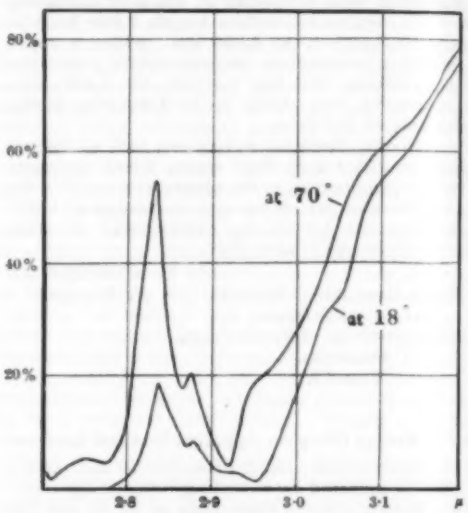
C. D. DARLINGTON.

Hyderabad.
Dec. 12.

[1] Gates, R. R., NATURE, **140**, 1013 (1937).
[2] Darlington, C. D., and La Cour, L., *Ann. Bot.* (in the press).
[3] Morgan, T. H., Bridges, C. B., and Schultz, J., *Carneg. Inst. Yearbook*, **32**, 296 (1933).
[4] Riley, H. P., *Cytologia*, **7**, 131 (1936).
[5] Mather, K., *Proc. Roy. Soc.*, B, **124**, 97.
[6] Gates, R. R., "Proc. 25th Ind. Sci. Cong. 1938, Abstracts", p. 143.

Hydroxyl Frequency in Carboxylic Acids

THE recent work of Errera and Mollet[1], Fox and Martin[2] and others has shown how the association of single molecules of the alcohols may be studied by means of their infra-red absorption spectra, more particularly in the region of the 'O—H' fundamental frequency and its overtones. In the course of an investigation (suggested by Prof. E. K. Rideal) of the inter- and intra-molecular interactions of the hydroxyl (OH) and carboxyl (COOH) groups in solutions of the ω-hydroxycarboxylic acids, we have been making a preliminary study of the infra-red absorption of some of the simpler carboxylic acids in solution and have established the existence of a similar phenomenon for association of these acids. Although indications of this have already been apparent from the work of Gillette and Daniels[3] on the shift of the 'C=O' and 'C—O' frequencies during association, and from that of Badger and Bauer[4] on a presumed overtone of the 'O—H' frequency in the photographic region, the effect of association on the fundamental 'O—H' vibration would appear to have been missed. Yet here the effect may best be studied and presents (as we have found) several interesting contrasts to the case of pure hydroxyl interaction in the alcohols.



Our results are best described by reference to the accompanying graph, which shows the absorption of a 0·0167 molar solution of benzoic acid in carbon tetrachloride at temperatures of 18° C. and 75° C. It will be seen that at ordinary temperatures there is a very weak band at 2·837 ± 0·003 μ, which greatly increases in intensity on raising the temperature. This corresponds exactly to the behaviour of the 2·76 μ band of the alcohols, indicating the formation of a greater concentration of the monomeric molecules at the higher temperature. The shift in the position of the characteristic OH absorption from 2·76 μ to 2·84 μ is of particular interest in distinguishing the OH group in a carboxylic acid from the OH group in an alcohol.

Acetic acid gave results exactly similar to the above, but an investigation of trichloracetic acid was more interesting in that the monomeric OH frequency was shifted to 2·860 ± 0·003 μ. This indication of a slightly weaker OH bond presumably corresponds to

its behaviour as a much stronger acid than acetic. We have also found that the apparent gradual shift in the 'C=O' frequency at 5·8 μ observed by Gillette and Daniels is really due to there being two separate bands, one coming from the monomer and the other from the dimer.

Another important result from the examination of trichloracetic acid was the discovery of an extremely broad absorption band near 3·3 μ, the intensity of which decreased with rise of temperature. It is difficult to see how this can be anything other than an "association band" corresponding to that in the alcohols at about 2·95 μ.

It should be added that the variation in the monomeric OH band was also achieved by varying the concentration of the acid in the solvent and measuring the integral absorption. The possibility of determining the heat of association of the acid in solution from the integrated absorption curves at different temperatures is being investigated.

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Laboratory of Colloid Science,
Laboratory of Physical Chemistry,
Cambridge. Jan. 31.

[1] Errera and Mollet, NATURE, 138, 882 (1936).
[2] Fox and Martin, *Proc. Roy. Soc.*, A, 162, 419 (1937).
[3] Gillette and Daniels, *J. Amer. Chem. Soc.*, 58, 1139 (1936).
[4] Badger and Bauer, *J. Chem. Physics*, 5, 852 (1937).

Separation of the Glucolytic Enzyme System from the Brain Cells and its Coenzymes

NUMEROUS attempts have been made in the past, with little success, to separate the glucose-splitting enzyme system from brain cells[1,2,3]. The most active extract obtained hitherto had less than 1/20 of the activity of the original tissue[3].

A cell-free brain extract has been prepared with about twice the glucolytic activity of intact brain cells. On cytolysis, a potent inhibitor of glycolysis is liberated from brain. This inhibitor, which is probably an enzyme, does not pass into the extracts if the extraction is carried out in slightly acid medium (pH 5·5–6·0). Such an extract contains the glycolytic system but no inhibitor. It has a very slight glucolytic activity. By the addition of suitable activators or coenzymes, however, the glucolytic activity of this extract may be increased up to 2–3 times that of intact brain cells.

One of the coenzymes—the nature of which is yet unknown—is contained in boiled extracts of beer-yeast, in boiled muscle extracts and, in small amount, in boiled extracts of brain. Creatinephosphate was found to be a specific coenzyme of the glucose-splitting enzyme system. Glutathione and cozymase are also required for full activation.

Lactic acid is also formed by brain extracts from glycogen on addition of boiled yeast extract, adenosinetriphosphate and cozymase. About three times more lactic acid is formed from glucose than from glycogen. Creatinephosphate has no activating effect on lactic acid formation from glycogen, although it strongly activates lactic acid formation from glucose.

The extracts are made by grinding one part of rat brain with three parts of ice-cold distilled water and one part of 0·1 *M*. phosphate solution of *p*H 5·5–6·0. After standing on ice ten minutes, the suspension is centrifuged. Air-dried beer-yeast is extracted with three parts of water. The centrifuged yeast extract is heated in boiling water for three minutes.

Table 2.

	From glucose		From glycogen	
	lactic acid	P_2O_5	lactic acid	P_2O_5
	mgm.	mgm.	mgm.	mgm.
Start	—	3·92	—	4·14
15 min. at 37° C. ..	0·42	3·77	0·22	4·01
35 „ „ „ ..	1·05	3·56	0·44	3·96
70 „ „ „ ..	2·57	3·14	1·12	3·87

The experiments described here were made by mixing 2 ml. of brain extract with 1 ml. of boiled yeast extract and making it up with the additions to 6 ml. Activators were added in the following amounts: 2 mgm. adenosinetriphosphate (*Ap*), 3 mgm. creatinephosphate (*Cr–P*), 2 mgm. glutathione (*GSH*), 1 mgm. cozymase (*Co–Z*). 1 ml. of brain extract corresponds to 0·2 gm. fresh brain.

The same amount of lactic acid is formed from glucose alone as from glucose and glycogen when both are added to the same flask. In one experiment, for example, 3·27 mgm. lactic acid was formed from glucose alone, 1·05 mgm. from glycogen and 3·19 mgm. in a flask where both were added together. It seems, therefore, that the glucolytic and the glycogenolytic enzyme systems in brain, though different, probably have common components.

Table 1.

	Lactic acid formed by 10 ml. extract (corresponding to 2 gm. brain) in 1 hr.	
	from glucose	from glycogen
Brain extract alone	0·22 mgm.	0·24 mgm.
„ „ and boiled yeast extract	0·56 „	4·44 „
„ „ „ „ „ and *Co–Z*	4·21 „	7·22 „
„ „ „ „ „ „ and *Ap*	4·28 „	7·78 „
„ „ „ „ „ „ „ and *GSH*	6·28 „	7·91 „
„ „ „ „ „ „ „ and *Cr–P* ..	24·68 „	7·85 „
„ „ and all the former activators without yeast extract	0·72 „	1·04 „
2 gm. brain pulp ground in Ringer sol. and all activators added	12·24 „	1·05 „

No lactic acid was formed by brain extract from substances contained in boiled yeast extracts.

A glycogenolytic enzyme system has been found in brain extracts which is activated by boiled yeast extract, adenosinetriphosphate and cozymase. Creatinephosphate has no activating effect on lactic acid formation from glycogen, although it strongly activates lactic acid formation from glucose.

Inorganic phosphate (or creatinephosphate) is esterified in brain extracts during glycolysis as shown in Table 2. (Inorganic phosphate includes creatinephosphate.)

The experiments described above indicate that the observations made on intact brain cells are not valid for cell-free extracts.

Full details will be published elsewhere.

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[1] Mazza and Malaguzzi-Valeri, *Boll. soc. Ital. Biol. sper.*, 10, 722 (1935).
[2] Geiger, A., *Biochem. J.*, 29, 881 (1935).
[3] Euler, Guenther and Vestin, *H.-Seyl. Z.*, 240, 265 (1936).

Mechanism of the Biological Synthesis of Acetylcholine

Stedman and Stedman have stated in a recent issue of NATURE[1] that the presence of acetoacetate leads to acetylcholine synthesis in the brain. The evidence for this conclusion is apparently the fact that the rate of acetylcholine formation by brain tissue macerated in the presence of chloroform and eserine and incubated at 37° is increased on the addition of sodium acetoacetate to the macerate.

Such evidence by itself seems to us quite insufficient to justify the conclusion that acetoacetate takes part directly in acetylcholine synthesis. In the first place, we have found that the rate of acetylcholine formation by ox brain tissue, treated in the manner adopted by the Stedmans, is greater at 18° (room temperature) than at 37°. In fact, this so-called synthesis of acetylcholine is no less at 0° than at 37°. Acetylcholine production by chloroform-treated brain in the absence of added acetoacetate at 18° is greater than that which occurs at 37° in the presence of acetoacetate. At 45° the apparent synthetic action of acetoacetate in the presence of whole ox brain is marked (even exceeding the 100 per cent increase claimed by the Stedmans to take place chiefly with the basal ganglia) but the greatest rate of acetylcholine formation found at this temperature in the presence of acetoacetate is less than that which occurs at room temperature in the absence of acetoacetate. At room temperature where, under the Stedmans' conditions, there is considerable formation of acetylcholine, the addition of acetoacetate has little or no effect.

We have further found that, under conditions approximating as closely to the physiological as possible, substances such as glucose, sodium lactate and sodium pyruvate effect rates of synthesis of acetylcholine in brain tissue which are six to ten times that which take place when such substrates are not added[2]. Yet under these optimal conditions for acetylcholine synthesis in the brain, the addition of sodium acetoacetate has little or no effect on the synthesis.

It seems to us that the acetoacetate effect noted by the Stedmans is connected with the peculiar conditions under which their experiments are carried out. Maceration of brain tissue with chloroform in the presence of eserine, and incubation of this in the absence of buffer solutions or physiological media at 37° under semi-anærobic conditions, certainly leads to free acetylcholine formation, but the mechanism of this formation requires elucidation. Until this elucidation has been obtained it seems to us rash to conclude, if a given substrate increases the rate of formation of acetylcholine, that this substance necessarily takes part in the synthesis of acetylcholine. Our own results lead us to believe that the action of chloroform on minced brain tissue is greatly to accelerate the breakdown of a complex precursor into free acetylcholine. We consider it likely that the Stedmans' results are connected not with a true synthesis of acetylcholine but with the breakdown of a precursor preformed in the brain tissue. Conceivably, under the conditions obtaining in the Stedmans' experiments, acetoacetate and other substances may affect the velocity of breakdown of the precursor.

It is difficult to compare the results of our experiments with those of Stedman and Stedman since the conditions under which they are carried out are so very different. But under our conditions, which very much more closely approach the physiological, there is as yet no evidence for the conclusion that acetoacetate is directly concerned with acetylcholine synthesis.

Our results and conclusions on the mode of synthesis of acetylcholine have already been communicated to the Physiological Society and will shortly be published in the *Biochemical Journal*.

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Jan. 19.

[1] Stedman and Stedman, NATURE, **141**, 39 (1938).
[2] See also Quastel, Tennenbaum and Wheatley, *Biochem. J.*, **30**, 1668 (1936).

Ethnographical Museums

THE student of ancient civilizations, who knows how much of the raw material of history is to be found in our museums, will be grateful to NATURE for the leading article in the issue of January 29 on the purpose and function of ethnographic collections.

The critics of the India Museum in South Kensington, some of whom are apparently prepared to view with equanimity the dispersal of the present collection, will have served a useful purpose if they have directed attention to the interesting experiment in arrangement which is being made under the present keeper, to whom a well-deserved tribute is paid in the article. Those readers of NATURE who are familiar with the report of the Museums Association on the museums of India, and who know from its contents how many collections of antiquities in India have defied arrangement and continue to defy examination by the specialist and student, will best be able to judge how much has been done for the study of Indian civilization by the authorities responsible for our own museum in London. The detailed accounts of Indian history and mythology that accompany the exhibits are a model of what such things ought to be. Indeed, the masterly sketch of the influence of classical art in India on the wall next to the exhibition of the recently acquired sculptures from Hudda in the entrance hall is one that even the specialist may ponder with profit.

The amalgamation of the Indian collections in South Kensington and in the British Museum would provide in London a permanent centre for the study of Indian history and Indian art, which would have no equal in Europe. The advocates of an Indian exhibition, as a step towards the solution of this problem, will command less support from students and scholars. It is appropriate to ask whether those enthusiasts for cultural relations who recommend a temporary Indian occupation of Burlington House, London, have carefully considered what they propose to exhibit. The Ajanta caves cannot be brought to the Royal Academy, nor the gateway of the Sanchi Stupa (a plaster copy of which towers over the staircase in South Kensington), nor, for that matter, the remains that still lie buried under the soil of India and of neighbouring countries, awaiting the spade of the archæologist. A mere exhibition of arts and crafts would involve just that divorce between art and life which, as is pointed out, is such a disservice to the

student of any civilization. It is precisely because the authorities who are now responsible for the Indian Museum have not confused the function of a museum with that of an art gallery, that wide support should be given to any proposal to bring together the various Indian collections in London under one roof and under their control.

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Feb. 4.

Realistic Social Studies

I DID not see the leading article on "Realistic Social Studies" in NATURE of January 22 until more than a fortnight after its publication, when it seemed already too late to offer any comments on it. As, however, NATURE of February 12 contains a further reference to this article and to the London School of Economics and Political Science, of which I was until recently director, I hope I may be allowed to make some comments now, registering disagreement on two points and agreement on one.

My first disagreement is with the statement in the NATURE article that I graduated in astronomy. It is true that at one time I aspired to be an astronomer, and, with that in view, studied mathematics for my first year at Oxford. But at the end of that year I became convinced that I was not a mathematician, and less rightly that there was nothing more to be discovered in astronomy.

My second disagreement is with the suggestion, which perhaps was not intended but which appears to arise out of the article, that the Rockefeller Foundation declined to renew a grant to the School of Economics because of some special dissatisfaction with the economic teaching and research of that institution. It is a matter of common knowledge that at the end of 1934 the Rockefeller Foundation adopted a new policy in regard to the social sciences generally. This policy excluded the indefinite continuance of any grants similar to those which had been made for several years by the Foundation to the School, but, subject to this, it is, I think, fair to say that the Foundation treated the School with exceptionally friendly consideration rather than the reverse. The new policy involved termination of grants to many institutions all over the world. The temporary renewal on a tapering basis of the grant to the School, which was due to terminate immediately after the adoption of the new policy, was not a blow at the School, but a piece of special consideration for it.

My third point, of agreement, is with the view implicit in the NATURE article that progress in the social sciences depends upon their coming nearer to the natural sciences in methods and spirit. This I take to be the main point of the article, as it was the theme of my address on "The Place of the Social Sciences in Human Knowledge", of which a summary was published in NATURE of June 26, 1937 (**139**, 1117).

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Feb. 15.

Points from Foregoing Letters

Prof. W. L. Bragg and H. Lipson consider that the scattered spots observed by Dr. Müller in X-ray crystal photographs taken at an angle of nearly 90° for the incident rays—from which he had deduced comparatively wide lattice variations in individual crystals—may be due to the angular range of the diffraction of the radiation after specular reflection at each crystal plane, the small crystals being variously oriented. To test this view, they have rotated the crystalline specimen (copper wire) through an angle of 3° while exposed to X-rays, and find that the maxima of the intensities of the spots—now elongated into 'smears'—are not 'staggered', but fall into place below each other. This, they consider, proves that the crystal grains have identical spacings.

The paramagnetic absorption in iron alum is found by F. Brons and Dr. C. J. Gorter to be strongly stimulated at a frequency of $3{\cdot}7 \times 10^6$ and a temperature of 77° K. in the presence of a comparatively large constant field applied parallel to the alternating field. Absorption attains a maximum at 1,000 oersted.

A pair of spaced frame aerials can be used to determine the spread in direction of the rays scattered by reflection from the ionized *E* layer of the atmosphere, according to experiments by T. L. Eckersley. The apparatus described indicates that the observed sporadic echoes are reflected from high density patches in the *E* region, which are irregularly distributed both in time and in space.

It is pointed out by Drs. A. G. Gaydon and R. W. B. Pearse that the band spectrum observed by Mesnage and attributed to chromium chloride agrees closely with the already known spectrum of aluminium chloride.

To explain the registration, in the 'shadow zone', of the *P'*-earthquake waves—Prof. B. Gutenberg and C. F. Richter postulate that the velocity of the waves in the earth's core increases from 8 km./sec. at its surface (depth 2,900 km.) to 11·4 km./sec. at 5,150 km., and then decreases slightly to 11·3 km. in the central part of the core.

T. M. Martin and Dr. R. W. Pickford find that in the presence of 'glare'—such as produced by illuminated fog or by reflection of diffused light into the eye by a plate-glass at 45°—the relative apparent size of a disc at different distances is much nearer to what would be expected from the inverse square law than is the case under normal conditions. This may be attributed to the absence of 'distance cues' when the glare is strong.

A cell-free brain extract with about twice the glucolytic activity of the intact brain cells has been prepared by A. Geiger by carrying out the extraction in slightly acid media. The addition of coenzymes (found in extracts of beer-yeast, boiled muscle, etc.) is necessary and glutathione and cozymase are also needed for full activation.

Experiments on the formation of free acetylcholine by brain tissue macerated in the presence of chloroform lead Drs. P. J. G. Mann, M. Tennenbaum and J. H. Quastel to the view that the chloroform accelerates the breakdown of a complex precursor into free acetylcholine and this increases the rate of formation of acetylcholine. They throw doubt on the mechanism suggested by Stedman and Stedman who assumed that the presence of acetoacetate leads to acetylcholine synthesis in the brain.

Research Items

War and Morality among the Ngoni

THE interrelation of the moral code and the character of the community and its demands on the individual are considered by Dr. Margaret Read in a study of the moral code of the Ngoni of Central Africa in relation to their former military state (*Africa*, **11**, 1; 1938). Before the coming of the Europeans, the Ngoni were a nation under arms, to whom war had been in the first instance the means by which they maintained their right to settlement in a new country, and afterwards to extend their territory and acquire cattle. It was also, however, as affecting the individual, a moral training ground by which certain moral qualities were inculcated, especially after puberty, and by which they were taught that strength and bravery were not a momentary flash in times of stress, but the outcome of training and discipline and a clear conscience. If a man had committed adultery before going to war, he was 'afraid in his heart' lest he should play the coward. If a regiment failed to carry out its task, the cause was assumed to be some moral lapse. Apart from the conditions of war, the traditional sanctions were directed to preserving the solidarity of the State and to maintaining aristocratic traditions. The preservation of these traditions rested with the women of good family. The moral code, which was inculcated from infancy to puberty and marriage, and afterwards regulated the conduct of married life, was rigidly enforced in the interests of the community. Upon its observance depended the internal security of the State and the success of its arms in war. The situation to-day as regards sexual morality is deplored by the Christian and non-Christian Ngoni alike. They attribute it to the coming of the Europeans, which has torn up by the roots the sexual morality, which was so closely bound up with the needs of the community. The chiefs could no longer exercise control over the lives of their subjects, while the prohibition of war involved abolishing the regiments with their discipline and training.

The Desert Locust in Arabia

R. C. MAXWELL-DARLING has recently published an article on the outbreak areas of the desert locust (*Schistocerca gregaria*) in Arabia (*Bull. Entomol. Res.*, **28**, 605; 1937). In his capacity as locust investigator of the Imperial Institute of Entomology, the author undertook journeys in southern Arabia with the view of ascertaining whether there is likelihood of outbreak centres existing in that area. As the result of several years' work in the Anglo-Egyptian Sudan, Mr. Maxwell-Darling concluded that the only centres of outbreak of this locust in North East Africa lay on the Red Sea coast. This did not, however, rule out possibilities of such centres occurring in Arabia. As the result of 12 months' travel in the latter country, he concludes that the south part of the Red Sea coast and probably that of Yemen are outbreak areas. Concerning other areas, less definite conclusions were arrived at and, as the author points out, if the outbreak areas are properly defined and given the requisite organization, there is every hope that the desert locust might be destroyed before spreading beyond these areas. Large regions have been found to be purely invasion areas, in which outbreaks cannot originate, and only certain restricted areas have been proved to comprise outbreak centres. It has been shown that outbreaks of the desert locust can be suppressed at their source by timely application of poisoned baits. Such outbreaks were prevented, for example, in the Tokar district of the Sudan, during three successive years by the district commissioner and his staff.

Western Indian Ocean as a Faunal Unit

FURTHER evidence that the western Indian Ocean might be regarded as a faunal unit is offered by Dr. K. H. Barnard in his study of the Amphipoda of the recent John Murray Expedition (Scientific Reports, **4**, No. 6; 1937). The collection was not a large one, comprising only 116 species, almost all being well-known forms, but they provide useful zoo-geographical information for an area the amphipod fauna of which has remained hitherto practically unworked. That many of these Indian Ocean species extend along the east coast of Africa as far as the southern point of the continent is explained by Dr. Barnard as being due to the Mozambique-Agulhas current. Three problematical species which turned up in the material were *Karoga megalops*, *Sympleustes grandimanus* and *Thoriella islandica*, the first-named of which is known only from Iceland and Alaska in deep water, while the others are deep-water Atlantic forms. Dr. Barnard asks whether it is "too unreasonable to regard these deep-water forms from the Arabian Sea as relics of the Cretaceo-Tertiary Sea of Tethys". He mentions that Lieut.-Colonel Seymour Sewell had also previously found two or three species of arctic copepods in Indian waters.

Meteorology in Egypt

A VERY detailed study of wind, temperature and lapse-rate of temperature in the first sixty-one metres above the ground at Ismailia, on the shores of Lake Timsah, in Egypt, is contained in Geophysical Memoir No. 71, of the Meteorological Office, by W. D. Flower. The observations extend over a period a few days longer than twelve months, but in a climate of such a steady type this period is long enough for bringing out the essential diurnal and seasonal variations of these quantities. The thermal observations include continuous records of air temperature as registered by a platinum resistance thermometer at a height of 1·1 metres and of temperature differences between that height and a height of 16·2 metres, between 16·2 m. and 46·4 m., and between 46·4 m. and 61·0 m. A wind vane and a Robinson anemometer were mounted at the top of the latticed steel tower that carried the thermometers; in addition, there was a Dines pressure tube anemometer several hundred metres away from the tower, with its vane at a height of 15·2 m., and various thermometers of ordinary pattern much nearer to the ground. The analysis of this observational material has been carried out in the most thorough manner, in relation to season, type of sky, strength of wind, situation as regards the synoptic chart for the Mediterranean and neighbouring countries, etc. The results obtained are so many and of such equal interest that it is impossible to summarize them in a short note. This memoir will be a happy hunting ground for students of

dynamical meteorology who have theories to test, and above all for those especially interested in terrestrial and atmospheric radiation, for both the inward radiation from the sun and the terrestrial radiation from the ground act powerfully upon the atmosphere in turn each day, under a sky that is very rarely overcast, and yet there is enough water vapour to lead to fog and low cloud at times just before sunrise, and well-marked thermal effects can sometimes be traced to the radiation and absorption of this suspended water and water-vapour.

Use of Pulverized Fuel in Cylindrical Boilers

DURING the last few years, the Fuel Research Station's programme of experimental work on pulverized fuel has included a great deal of research on the use of this fuel in cylindrical boilers. Mr. T. F. Hurley has undertaken to present to the Institute of Fuel a series of papers dealing with results obtained at the Station. His first paper, read to the Institute on December 7, goes far to quash the prevalent idea that powdered coal cannot be successfully applied to Lancashire boilers owing to the smallness of combustion space available as compared with water-tube boilers. In the case of water-tube boilers it is impracticable to reduce the size of combustion chambers owing to the tendency for molten ash particles to be carried out of the furnace. In the case of Lancashire boilers, however, the ratio of boiler heating surface to furnace volume is far higher than that of water-tube boilers. Thus a correspondingly greater heat release can be obtained without molten ash being carried out of the furnace. In this type of boiler, therefore, heat releases are governed primarily by combustion conditions. Admittedly, the high surface to volume ratio is not conducive to good combustion, but reasonably good results can be obtained by suitable methods of rapid ignition followed by rapid combustion. Vindication of the Lancashire boiler fired with powdered coal is substantiated by actual test figures which prove that it can be operated at loads far in excess of those normally obtained.

Cosmic Evolution

PART 5 of vol. 146 of Division 2a of the *Sitzungsberichte* of the Academy of Sciences of Vienna contains a paper on "The Evolution of a Cosmic Dust Cloud" by Prof. Hildebrand. He assumes the cloud to have initially the simplest properties which admit of dynamical treatment, that is, its density is uniform throughout and it is spherical in shape. Each particle is describing an ellipse with a natural period proportional to the 3/2th power of its distance from the centre of the sphere and inversely proportional to the square root of the mass of dust within that distance from the centre. The plane of the ellipse and the direction of motion round it are distributed at random. Impacts between the particles are taken as inelastic. Under these conditions the author shows that impacts will produce mass conglomeration and a tendency for the augmented mass to move in paths nearer the centre of the cloud than before the impact. This increases the central field of force and the central tendency is augmented. In addition the concentrated masses tend without impacts to carry with them an atmosphere of smaller dust. The planes of motion of the masses which effect the primary concentration about the centre determine the "invariable plane" of Laplace, the direction of motion in that plane, and the tendency of the cloud to assume the disk form. This, the author points out, is the first step towards the production of a central system such as the solar system. He proposes to deal in a later paper with the consequences of the heat developed by the non-elastic impacts which he postulates.

Radial Velocities of Cepheid Variables

AN important addition to our knowledge of Cepheid variables has been made by Prof. A. H. Joy (*Astrophys. J.*, **86**, 363) who has made a series of velocity observations of 128 stars of this class. Our previous knowledge of Cepheid velocity curves was confined to 29 stars which had been measured frequently and were known with considerable accuracy. Joy has abandoned the practice of intensive observations of selected stars, and attempted a general survey of the fainter Cepheids, using the minimum number of observations of each which would give a reasonable approximation to its velocity curve. Using low-dispersion spectrographs he has been able to extend observations to stars of magnitude 14, and now, in declinations north of −40°, only 35 Cepheids are left for which no observations are available. These are mostly fainter than the fourteenth magnitude. Full details of the individual measures are given, together with diagrams of the velocity curves of 106 stars and a table showing the various data available for 155 Cepheids as deduced from the present observations and including previously published results. A short discussion of the relationships between period and certain characteristic properties of the stars is also given in the light of this extensive new material.

The System of α Ursæ Majoris

THIS is the title of a paper (*Mon. Not. Roy. Astro. Soc.*, **98**, 2; December 1937) by Dr. H. Spencer Jones and Mr. H. H. Furner. The duplicity of the star was discovered by Burnham in 1889, the separation being then 0″·9, but this had decreased to 0″·6 in 1902, and after this the companion was not seen until 1933. The paper contains a very full description of the meridian observations made at Greenwich and also of the double star observations, as well as a summary of the radial velocity measures made at Lick Observatory. Combining the results, the orbital elements and the mass of each component are deduced. Taking the mass of the sun as unit, the masses of the brighter star and its companion are 2·14 and 0·96 respectively, but a serious discrepancy arises when the mass-luminosity relationship is utilized to find these masses. Use is made of the tables in Eddington's "Internal Constitution of Stars", and it is shown that agreement is reached by the masses derived by this method and from the orbital elements when the parallax is 0″·022. The masses of the components are 8·6 and 3·8 and the velocity of the centre of gravity of the system is − 8·72 km./sec. If the elements so derived are correct, it is difficult to explain the fact that the companion was not seen between 1905 and 1933, as the separation would have been sufficient then for its detection. It is suggested that there may be variation in its brightness, and it may be recorded that a similar hypothesis for the companion of Procyon is the only explanation of the failure to see it from 1914 onwards. Further observations of the α Ursæ Majoris system are highly desirable.

Pithecanthropus and *Sinanthropus*

By Prof. Franz Weidenreich, Cenozoic Research Laboratory, Peiping Union Medical College

DR. R. VON KOENIGSWALD in No. 5147, vol. 191, of the *Illustrated London News* (December 11, 1937) gave an account of the discovery of another *Pithecanthropus* skull in Java and a lower jaw fragment which he also attributes to *Pithecanthropus*. As emphasized in the introductory note by Sir Arthur Keith, these discoveries are of the utmost importance to our knowledge of the history of early man. All students interested in palæoanthropology will, I am certain, appreciate Dr. von Koenigswald's enthusiasm and eagerness in the search for traces of the Java hominids, an undertaking which has now met with remarkable success.

A controversy of many years' standing has suddenly been brought to an end. It may now be considered a certainty that *Pithecanthropus* is not a giant gibbon but a genuine hominid, a fact already demonstrated by Weinert's reconstruction of *Pithecanthropus* Skull I and by the discovery of *Sinanthropus*. In a recent article[1], I have been able to demonstrate that *Sinanthropus* Skull II of Locus *L*, recovered in November 1936, completely conforms in relation between height and length and in other details to the *Pithecanthropus* cap. The more pronounced flatness of the forehead is compensated by a stronger depression in the obelion and lambda region of the former. The new and more complete *Pithecanthropus* skull, which is the very image of the first, confirms this statement. Since the entire temporal bone is preserved, the absolute height of the brain case can be defined and thus permits calculation of the height-length index. This index is the same as in *Sinanthropus* Skull II of Locus *L*; as a matter of fact, it is even somewhat higher than in the latter. The close relationship between *Pithecanthropus* and *Sinanthropus* can no longer be doubted.

With respect to the special nature of the relationship, however, I regret to say that I am unable to accept von Koenigswald's conclusions. He considers *Pithecanthropus* to be more primitive than *Sinanthropus*. This claim is based upon two points: namely, upon the cranial capacity of *Pithecanthropus*, which he estimates to be only 750 c.c. and thus rather inferior to that of *Sinanthropus*, and upon the complete absence of the mastoid process. I doubt the correctness of the first statement. According to the photographs, the greatest length of *Pithecanthropus* Skull II is the same as that of Skull I (about 180 mm.), the greatest breadth (about 140 mm.) only 4 mm. less than that of *Sinanthropus* Skull *E*, and the auricular-bregma-height 95 mm. (against 93 mm. in *Sinanthropus* Skull *E*). The cranial capacity of *Sinanthropus* Skull *E*, however, amounts to 915 c.c. according to exact measurements of the endocast. Unless we consider that the bones of the *Pithecanthropus* Skull II are considerably thicker than the already exceptionally thick bones of *Sinanthropus* Skull *E*—a rather unlikely feature according to von Koenigswald's photographs, especially if the skull is considered to represent a female individual as is surmised by him—it is impossible that the cranial capacity of that skull could be inferior by as much as 165 c.c. According to my own estimation, the cranial capacity cannot be less than 850 c.c. With such a low cranial capacity, *Pithecanthropus* still falls within the range of variation of *Sinanthropus*, for Skull I, recently described[2], certainly did not exceed the 850 c.c. limit. The fragments of the frontal and temporal bones of this *Sinanthropus* skull are considerably smaller than the corresponding parts of the *Pithecanthropus* Skull II. The smallness (complete absence ?) of the mastoid process cannot be considered a standard feature of primitiveness as is suggested by Koenigswald. *Sinanthropus* also shows a very great variability in the size of this protuberance. This process in the Krapina skull is exceptionally small, while in the Rhodesia skull it is as well developed as in recent man.

On the other hand, it should not be overlooked that all *Sinanthropus* skulls exhibit one real primitive feature which is completely lacking in both of the *Pithecanthropus* skulls, namely, the separation of the supraorbital ridges from the forehead by a distinct and broad furrow. In *Pithecanthropus* these ridges continue within the frontal squama, as is also true of the skulls within the whole Neanderthal group.

The entire discussion of the degree of primitiveness, however, is of secondary nature. When compared with other fossil hominids, there is no doubt that *Pithecanthropus* and *Sinanthropus* represent the same general stage of evolution as affirmed by M. Boule, who recently combined the two types under the common name "préhominiens". The differences existing between the two types must be considered as regional or racial deviations. Neanderthal man, as well as recent man, as a rule displays in details a great number of primitive and progressive features existing side-by-side, regardless of the general classification of the types within the order of hominids. Hence, *Sinanthropus* may have retained a primitive character in one of the structures and, perhaps, *Pithecanthropus* in another.

The new discovery of the mandible points exactly in the same direction. Since both the jaw and teeth are rather strongly developed, I doubt whether they actually belong to individuals characterized by such small skulls as the *Pithecanthropus* skulls, although the restorer of the entire head took such a condition for granted, judging by the photograph in the *Illustrated London News*. In the case of *Sinanthropus*, the small skulls (female) have small jaws with relatively small teeth. The mandible fragment, judged by size only, would rather fit the large skulls of *Homo soloensis*. In any event, the teeth are interesting because of the extensive combination of primitive and more advanced characters. The increasing size from M_1 to M_3 is a primitive feature, whereas the shape and patterns of the second premolar and the first and second molars suggest a much more advanced type when compared with the *Sinanthropus* teeth. All the peculiarities specific to primitive *Sinanthropus* teeth are absent in these *Pithecanthropus*

teeth (compare my publication on the *Sinanthropus* dentition[2]). Therefore, should the mandible really belong to *Pithecanthropus*, then the degree of primitiveness would once more be directed towards *Sinanthropus*.

The *Pithecanthropus* problem, however, cannot be discussed without referring to *Homo soloensis*. In the publication quoted above[1] I have directed attention to the fact that *Homo soloensis* bears so close a resemblance to *Pithecanthropus* that a conception is suggested that the former represents a male and the latter a female individual of one and the same type. The recovery of the new skull exhibiting the same shape and size as the first one supports this idea. I know that geological conditions seem to contradict such a combination, but as a matter of fact, the similarity is so striking that *Homo soloensis* must at least be considered the next further advanced phase of *Pithecanthropus*. In this connexion, it must be borne in mind that within the *Sinanthropus* group there are small and large skulls with their cranial capacities varying from 850 c.c. to 1,220 c.c. and with corresponding differences in shape and features. At any rate, further discoveries will certainly contribute towards a better understanding of the existing relations.

Thus we proceed to another question raised in von Koenigswald's article. Koenigswald considers the baby skull of Java, the so-called *Homo modjokertensis*, though with certain reservation, as an infantile *Pithecanthropus* skull. Sir Arthur Keith agrees with von Koenigswald on this point. Again, I doubt the correctness of such an interpretation. Since the skull belongs to a very young child, it is difficult to judge it on the basis of criteria valid for adult skulls. This is especially true of the relation between height and length. We know that in young individuals, even in anthropoids, the forehead is much more erect and hence the relative height of the brain case much higher than in adult skulls. However, there are two facts, which, in my opinion, are incompatible with the assumption of a direct general relation between that baby skull and *Pithecanthropus*, so far as the latter is represented by the two adult skulls. One fact is the circumstance that the length of the sagittal border of the parietal bone of the baby skull considerably exceeds the corresponding length of the frontal bone. Such a feature is rather characteristic of recent man, whereas in fossil man and in the great apes exactly the reverse is true. Although that difference is less in very young than in adult skulls, it nevertheless exists. But in the baby skull of Java the length of the parietal bone is, without question, already considerably greater than the respective measurements of the adult *Pithecanthropus* skulls and the *Sinanthropus* skull taken for comparison above.

One other fact must be added. The occipital bone of the baby skull is rather equally curved in the inion region, whereas the adult *Pithecanthropus* and *Sinanthropus* skulls exhibit a distinct angle at this region between the upper and lower portion of the occipital squama. Although this feature may be found to be somewhat altered in young individuals also, it is important that a fragment of a *Sinanthropus* at our disposal which, according to its entire appearance, cannot be much older than the baby skull, shows that characteristic inion angle to be well pronounced already. For these two reasons, I am inclined to consider both of the peculiarities just described as an indication that the baby skull of Java represents a more advanced type than the two adult *Pithecanthropus* skulls, and must thus be attributed as belonging to a *Homo soloensis* type rather than to the latter.

The recent important discoveries of Java have solved one problem, but, as is common in such cases, they have at the same time raised new questions.

[1] Weidenreich, F., *J. Roy. Anthrop. Inst.* (in the press).
[2] Weidenreich, F., *Bull. Geol. Soc. China*, **16** (1936–37).
[3] Weidenreich, F., *Palæontologia Sinica*, N.S. *D*, No. 1, Whole Ser. No. 101.

Science in India*

Kala-Azar and Malaria

The conquest of kala-azar and certain observations on the chemotherapy of malaria were discussed in Sir U. Brahmachari's presidential address to the Section of Medical Research. The earliest epidemic of kala-azar in Bengal ('Burdwan fever') occurred in the seventies of the last century, when it was probably complicated with malaria. In this epidemic, the fell disease defied every human effort. In more recent times, the epidemic of the disease in the Nowgong district of Assam produced such an appalling mortality that there was a decrease of 31·5 per cent in population of the place in the decade 1891–1900. The mortality from the disease has now been reduced from 90 per cent or more to 1–2 per cent. Including complicated cases, it has been reduced from 99 to less than 10 per cent.

The conquest of kala-azar may be said to have begun when Cristina and Caronia obtained remarkable results in infantile kala-azar of the Mediterranean basin by the use of tartar emetic. It has been observed (Brahmachari and co-worker) that when metallic antimony is injected intravenously in a leishmania-infected experimental animal in a state of fine subdivision, the particles are picked up by the same cells in the spleen as those that harbour the parasites of kala-azar, and that the ensuing struggle results in the complete destruction of the parasites in the speediest way. It is one of the most powerful leishmanocides.

It has been found that, in the campaign against kala-azar, treatment with tartar emetic or sodium antimonyl tartrate had the disadvantage of being long and tedious. In Assam, which was once the hot-bed of the disease, mass treatment with these drugs was therefore found difficult to enforce, as patients discontinued treatment altogether or attended very irregularly after a few injections. It was felt that the difficulties in reducing the number of 'stopped treatment' cases would be overcome more effectively if some drug could be introduced which would be more efficacious than tartar emetic and take a much shorter time to effect a cure. Such a drug was found in 'urea stibamine'. Its value in the campaign against kala-azar in Assam is demonstrated from statistics in the Annual Public Health Reports of the Government of Assam.

* *Continued from p.* 340.

The figures for the Cachar district are very interesting. Out of 5,188 cases treated between 1925 and 1936, the number of deaths was 56, showing a percentage of less than 1·08. Out of 574 cases treated in 1936, the number of deaths was 2, showing a percentage of less than 0·3. The incidence of the disease in Assam has been reduced from 60,940 in 1925 to 10,587 in 1936, and the mortality from 6,365 to 753 during the same period. The disease has lost all its terrors in the Province, and people who suffer from it are less afraid than those who suffer from malaria.

The Kala-azar Commission, India, used, throughout the seven years of its existence, urea stibamine only, in the routine treatment of kala-azar. According to it, the acute fulminating type characteristic of the peak period of an epidemic responded to treatment with urea stibamine extraordinarily promptly and with an almost dramatic cessation of fever, diminution in size of the spleen and return to normal condition of health.

In 1933, the Director of Public Health, Assam, noted that "It is no exaggeration to say that approximately 3·25 lacs of valuable lives have been saved to the Province". In 1922, in studying the treatment of kala-azar, Sir U. Brahmachari observed certain remarkable skin eruptions caused by *Leishmania donovani* developing in kala-azar patients two or three years after completion of antimonial treatment and apparent cure, though, under ordinary conditions, in kala-azar the skin shows very little involvement or none (dermal leishmanoid). Viable leishmania have been cultured from these skin lesions in test-tubes and sandflies. They are therefore a source of infection, and the conquest of kala-azar cannot be regarded as complete unless these lesions are either averted or quickly cured. In the campaign against kala-azar and its conquest, proper handling of cases of dermal leishmanoid is an important point to be taken into consideration.

Research in malaria therapy has been intense in recent times. In certain parts of India it is of greater interest than kala-azar. The chemotherapy of quinoline and acridine compounds in malaria may one day play an important part in the campaign against the disease and its conquest. While some quinoline and acridine compounds have marked destructive action on paramecia, most of them have been observed to have no action on the parasites of malaria when used clinically in patients suffering from the disease.

Recently a compound having a similar composition to that of quinacrine or atebrin has been synthesized in Sir U. Brahmachari's laboratory. It has been used in the form of the hydrochloride or hydrobromide. Its action in benign tertian and malignant tertian infections in man is identical with that of atebrin. Shortt and Menon have observed that in a series of experiments carried out with this compound and atebrin on monkeys infected with *Plasmodium knowlesi*, the effect of the two drugs in sterilizing the peripheral blood, the cure rate, and relapse rate were identical.

The discoveries of effective anti-malarials and leishmanocides rank among the highest triumphs of synthetic chemistry in its application to tropical medicine.

Sir U. Brahmachari concluded by saying that if along with the conquest of malaria and kala-azar there is in India "a proper balance between labour-saving devices and industry-increasing discoveries", and if her people "will but decide to put in play the methods", which science to-day has provided for sufficient supply of food and clothing and shelter, then the health and economic problems of India, with her endless natural resources, will be solved to a great extent and much of her unrest and unemployment will cease, and she will have the opportunity of being richer, happier, healthier and freer than ever before.

PHYSIOLOGY OF THE INDIVIDUAL IN THE TROPICS

Bt.-Colonel R. N. Chopra discussed the physiology of the individual in the tropics in his presidential address to the Section of Physiology. With the development of bacteriology and immunology, medical science has been dominated by the conception of specific infection, and emphasis has been laid more on the invading organism than on the invaded patient. In modern physiology, also, a good deal of stress is laid on the cellular organization of living bodies and on isolated organs or tissues rather than on the organism as a whole. Man is an organic unity in relation to his surroundings, and therefore his normal physiological processes are likely to be modified by the environmental forces which are constantly impinging upon him. Like all other living organisms, he is endowed with powers of adaptation, and he reacts to his environment in such a way as to produce within himself ideal conditions for life within that environment.

The most important environmental factor affecting the dweller in the tropics is the high atmospheric temperature, associated usually with bright sunlight and excessive humidity. These three combine to make the primary demand on the body—that of heat regulation. There is evidence that acclimatization for generations to a hot climate has endowed the skin of the tropical races with the power of getting rid of excessive heat. The pigmented skin prevents the penetration of heat to the more sensitive tissues, and, by absorbing heat, allows stimulation of local heat receptors and consequent reflex sweating and evaporation. The sweat glands also appear to develop a special adjustment; the sweat is not only more abundant but also contains less chloride than that of the European, an indication that the body is striving to prevent an otherwise serious depletion.

Like the skin, the gastro-intestinal tract also shows some adaptive response. The cutaneous vasodilatation leads to splanchnic vasoconstriction, with diminution in gastric and biliary secretions, and possibly also gastro-intestinal atony, with their sequelæ of loss of appetite and constipation.

The respiratory and cardio-vascular systems also share in the process of adaptation; but it is doubtful whether any permanent change is brought about. Changes in water metabolism undoubtedly occur, with reflected alterations in the state of the body fluids, but the changes reported are not significant enough to deserve special attention. Examination of the blood shows that, contrary to the general belief, a tropical climate does not produce anæmia, but may actually have a stimulating influence on the hæmopoietic system.

There is no unanimity of opinion on the degree to which the nervous system is affected, and experimental difficulties make decision difficult. It seems certain, however, that, so far as the endocrine system is concerned, hot climate reduces the activity of the thyroid-adrenal apparatus. The expected lowering of the basal metabolic rate is, however, not observed.

The natural diet of the tropical native appears to be very well adapted to his environment. The low protein intake tends to keep heat production at a low level, fat is undesirable on account of its high calorific value, while carbohydrate, of which there is abundance, is, on account of its water binding power, ideally suited to promote loss of heat by evaporation.

It is clear that human individuals, like other organisms, receive modifying impressions from their physical environment. It is only natural that, in the process of adjustment, individuals residing in the tropics will develop physiological, biochemical, and possibly pathological states, which will be peculiar to the climatic type and different from others residing in other climatic zones. Unless these peculiar characteristics of tropical climate are known, no definition of a 'normal' individual will be possible. The determination of physiological 'normals' provides the essential base line for the study of disease, and therefore both physiologists and medical men should study the problems of environmental adaptation more intensively than they have so far done.

Ambivalence

In his presidential address before the Section of Psychology, Dr. G. Bose discussed "Ambivalence". It is well known that negativistic states occur both in normal and abnormal persons, and in some cases of dementia præcox the state may attain pathological proportions, but there is no generally recognized satisfactory explanation of the symptoms. Some would postulate an innate characteristic, prompting to contradictory emotional attitudes towards the same object, to which the word ambivalence is given; others tend to limit this attitude to the love-hate situation. Now although opposite types of behaviour in different circumstances and at different times are quite common among normal people, no one has sought to explain them by the theory of ambivalence. Strictly speaking, the ambivalency theory should be limited to cases where opposite tendencies are observed to be working simultaneously and so affecting behaviour, but because of the unconscious element ambivalence is never a matter of direct observation, and must therefore be regarded as an explanatory concept.

If it be assumed that the motive force of behaviour is *wish*, then it is easy to see that behind the emotional states of love and hate are wishes of opposite types; the real opposition therefore between love and hate lies in the contents of the corresponding wish situation. Only in the domain of a dynamic entity does the concept of opposition hold good, so that if we are to recognize an opposition between such elements as pleasure and pain, love and hate, subject and object, we must suppose that these entities are of the dynamic order. Pleasure and pain are opposites because they are usually associated with opposite types of reaction; otherwise they are just like any two different experiences, for example, red and green colours.

Still, neither the antithesis between love and hate, nor that between activity and passivity gives us any clue to the solution of ambivalence.

We might make the assumption that pairs of active and passive wishes of all sorts exist in the psyche. Ordinarily the wishes inhibit each other and the ego remains in a neutral state free from apparent strain. Sometimes in the presence of an object the equilibrium of the ego is disturbed and the wish corresponding to the objective situation is thrown out by the ego as a pseudopodium—to use a biological term. The subjective counterpart of the wish is felt by the ego as a striving towards the object. When the act is completed, the *subjective* striving finds satisfaction in the situation of the main ego and the *objective* striving in the situation of the object carried there.

Opposite pairs of wishes may, therefore, be supposed to exist in all wish situations. It is only where reciprocity is possible that the components of the pair become manifest. If there is a one-sided influence in childhood favouring one of the pair of opposite wishes, repression results. Repressed masochism makes sadism ambivalent and vice versa.

It is, then, better to consider ambivalence not as a fundamental trait of mental life, but to assume that pairs of opposite wishes are fundamental. The components of such pairs of wishes may have alternate complete satisfaction in reciprocal acts, and partial satisfaction with unpleasant emotion tones in retaliatory acts. They may not necessarily produce ambivalent states and even when they do, in many cases, the ambivalence is removable, thus showing that it is a repression product.

Physiography of Rajputana

Dr. A. M. Heron's address to the newly instituted Section of Geography and Geodesy on "The Physiography of Rajputana" summarized the results of his geological work extending over twenty years in that area.

Rajputana, covering 130,642 sq. miles, is roughly rhomb-shaped with E–W and N–S diagonals, of about 540 and 510 miles in length respectively. The Aravalli mountains intersect the area running N.E.–S.W., from Delhi to Gujarat, a distance of 430 miles. These mountains are a true folded range, deeply eroded at the present time, and are probably the oldest mountains in the world still remaining as a range. It is to the physical and geological features of the Aravalli hills that Dr. Heron pays particular attention.

After a brief mention of the Precambrian succession which forms the principal geological interest, Dr. Heron compares the present-day features of the two divisions into which the region is divided by the range. To the north-west the country is largely desert and, with the exception of the catchment basin of the Luni river, an area of enclosed drainage in which salt lakes have formed. The origin of the salt and the sand of the dunes of the *seif*, *barchan* and ordinary types is traced to the Rann of Kachh. The solid geology has little effect on the topography. South-eastern Rajputana is morphologically more varied, while desert conditions are replaced by a fairly well watered and comparatively fertile land. The relations between the geology and topography are discussed in some detail.

Dr. Heron then proceeds to his description of the Aravalli range. After pointing out that, in contradistinction to the rest of India, the folding continued to a geologically much later date since the Vindhyan rocks have been affected, he proceeds to show that the Aravalli range was in existence forming a barrier between the two areas (west and east) in which the Vindhyans were laid down. The uplift is considered to be pre-Vindhyan in age.

Referring to the folding of the range and the rocks which were involved, Dr. Heron directed attention to the fact that, in spite of its name, the Aravalli range is composed mainly of rocks of the Delhi System. This system lying unconformably on the Aravalli System is developed in a geosyncline with the softer Aravalli rocks exposed on the flanks. The higher grade of metamorphism and the greater amount of igneous intrusion in the Delhis is attributed to the deeper infolding in the synclinorium and the consequent greater temperature and pressure. The synclinorium is compared to a double fan. Where the handles meet, the folding is believed to be that of a simple syncline, spreading out at either end by the appearance of further folds, by the thickening of some of the formations and by deeper folding bringing higher beds into the core. Details of folding and faulting along the range are given.

Dr. Heron then proceeded to discuss the Mesozoic rejuvenation of the Aravalli range, which was accompanied by the formation of the Great Boundary fault and the disturbance of the Vindhyan rocks. On the evidence given he arrives at the important conclusions that the range was peneplaned during the Mesozoic, at some period not much earlier than the Cretaceous, and was re-elevated before the beginning of the Tertiary.

Evidence was brought forward to suggest the existence of a second peneplane of Tertiary age, while a third of Pleistocene age, the 'Bhangar' or older alluvium, is also present.

Medicine and Eugenics

IN the Galton Lecture delivered before the Eugenics Society on February 16, Prof. John A. Ryle, regius professor of physic in the University of Cambridge, pointed out that the aims of the science of medicine and the science of eugenics are in many respects identical. Medicine, however, in the past has paid too little attention to inheritance, and eugenics too little attention to environment. The neglect of eugenics by the medical profession is shown by the fact that out of approximately 650 members of the Eugenics Society only one fifth are medical men.

Prof. Ryle urged that fuller consideration than at present should be given to genetics in the medical curriculum from the first year of biological study and continued until the final clinical year. He suggested that a study of animal genetics should be substituted for some of the routine morphological study in zoology, and that reproduction, genetics, growth and nutrition should take the place of the more specialized biochemistry and biophysics.

It is, moreover, important that the family doctor should be able to give advice on such subjects as sterilization of the unfit and taxation relief for the encouragement of healthy parenthood, and should be familiar with the significance of population fluctuations, the various causes of decline in physical standards, the origin of mental defect, and so forth. It is owing to the medical profession being insufficiently instructed that members of the lay public have to content themselves so frequently with quacks, doubtful literature and advertisements. Prof. Ryle maintains that it is the function of the medical profession to advise politicians in the matter of planning for a health campaign. In addition to nutritional reforms, housing improvements and other comparable measures within the purview of State medicine, statesmen, communities and individuals alike should devote their attention to the study of pedigrees and encourage an optimum fertilization rate. Owing to the present lack of co-ordination within the medical profession and reliance on local enthusiasm and sporadic individual efforts, progress is necessarily slow. What is wanted is a drastic reorganization on a large scale such as is being carried out in the U.S.S.R.

In conclusion, Prof. Ryle made the following recommendations: First, a national council of medicine, eugenics and sociology should be formed not only to direct education and research in human genetics and social reorganization, but also to transmit to the legislative councils accumulated information with suggestions for reform. Secondly, more stress should be laid in the medical curriculum upon all preventive aspects, especially the preservation of health by nutritional and other social reforms and the application of human and animal genetics to eugenic education. Thirdly, existing organizations, eugenic and sociological, should be employed to interest the medical profession in the preventive and educational role which they should play by instruction in domestic eugenics. Fourthly, a limited number of chairs or readerships should be founded in human genetics, the study of which should be carried on in close association with animal genetics and the biological sciences on one hand and the clinical sciences on the other.

University Events

ADELAIDE.—Dr. James Davidson, head of the Department of Entomology at the Waite Agricultural Research Institute of the University, has been appointed to the Waite professorship of entomology.

CAMBRIDGE.—R. H. Angus, of Sidney Sussex College, has been appointed University lecturer in engineering.

Prof. A. R. Radcliffe-Brown, of Trinity College, professor of social anthropology in the University of Oxford, has been appointed to the Frazer lectureship in social anthropology for the academic year 1938–39.

H. E. Hinton, of King's College, has been appointed junior curator of the Museum of Zoology.

The Raymond Horton-Smith Prize for 1936–37 is awarded to Dr. H. L. H. H. Green, of Sidney Sussex College, for a thesis entitled "Monotreme Teeth: a Study in Mammalian Tooth Development".

The Appointments Committee of the Faculty of Archæology and Anthropology expects to proceed shortly to the appointment of a University lecturer in anthropology. In making the appointment preference may be given to candidates having experience of Oceania and the Pacific area and a knowledge of their peoples. Further particulars may be obtained from Mr. M. C. Burkitt, secretary of the Appointments Committee of the Faculty, Museum of Archæology and of Ethnology, Cambridge, on or before May 28.

EDINBURGH.—The Cameron Prize for 1938 has been awarded to Dr. Karl Landsteiner, member of the Rockefeller Institute for Medical Research, New York, in recognition of his researches on isohæmagglutinins and blood-groups and the influence of his discoveries on the practice of therapeutic blood transfusion.

Science News a Century Ago

Druidical Temples

AT a meeting of the Royal Irish Academy on February 26, 1838, reported in the *Gentleman's Magazine* of the following June, Mr. Petrie gave an account of a very remarkable collection of stone circles, cairns, etc., situated in the town of Carrowmore, in the parish of Filmacowen, and about two miles from the town of Sligo. They were of the class popularly called druidical temples, and had in every instance, one or more cromlechs or kistvaen within them. Many of these monuments were greatly dilapidated, but there were still existing vestiges of about sixty circles with cromlechs, and it was known that a vast number had been totally destroyed by the peasantry. They were all formed of granite boulders except the covering of stones and another of the cromlechs in the great cairn, which were of forms. In all the circles which had been either wholly or in part destroyed human bones and their urns, etc., had been invariably found, and one circular enclosure, outside the group, and of far greater extent than any of the others, but evidently of contemporaneous construction, was filled with bones of men and animals. Mr. Petrie stated that this was the largest collection of monuments of the kind in the British Isles and probably, with the exception of the monuments at Carnac in Brittany, the most remarkable in the world.

The Frozen Soil of Siberia

AT a meeting of the Royal Geographical Society held on February 26, 1838, a paper by Prof. Karl Ernst Baer (1792–1876) entitled "On the Frozen Soil of Siberia" was communicated by Vice-Admiral von Krusenstern. It had long been ascertained, said Baer, that over a great extent of the country, the soil in Siberia was never entirely free from ice. During the summer, the surface of the ground was to a greater or less depth, thawed, but at some distance from the surface a bottom of perpetual ice was met with. Gmelin, the elder, had stated that shortly after the founding of the town of Yakuzk (in lat. 62½° N., long. 130° E. nearly) the soil was found to be frozen to a depth of ninety-one feet and the sinking of a well had to be abandoned. Within the last few years, however, a merchant having attempted to sink a well in that town, was persuaded by Admiral Wrangel to continue his operations until he had penetrated the whole stratum of ice. This he did, keeping a journal of his work. The pit was sunk to a depth of 382 feet, when loose soil was encountered, the temperature of the earth being ½° Réaumur. The temperature at various depths was as follows :

−5 at	77 ft.	−1½ at	305 ft.
−4 „	119 „	− ½ „	350 „
−2 „	217 „	½ „	382 „

This immense thickness of ground ice would prove that Siberia must have been for a long period in the physical condition as it was at present. In the actual state of our information it was impossible to determine how widely the layer of ground ice was spread under the surface of Siberia. In concluding his paper, Baer said it would be interesting if the Geographical Society would collect information respecting the extent of the layer of ground ice in North America.

Faraday's Experiments on Conduction

ON February 26, 1838, Faraday recorded in his Diary :

"Made some expts. with 6 of Daniells' cells on conducting power conferred on water by acids, salts, etc. Found them very different and for a first approximation may arrange them into three classes. *Sulphuric*, *Nitric*, *Oxalic* and *Phosphoric* acids gives much power.

Tartaric and *Citric* acids ; *Potassa*, *Soda*—*Carbonates* of *potassa*, *Soda* and *ammonia*—*Sulphate of soda*—*Nitre* and *Bicarb. soda*—give less.

Acetic and *Boracic* acids—*Ammonia*—*Corr. Sublimate*—*Percyanide* of *Mercury*—*Iodine*—*Gum* and Sugar—give no sensible power tested by Volta meter but would probably by the Galvanometer.

The results are useful general approximations."

Early Proposals for Steam Navigation

ON February 26, 1838, Prof. Stephen Peter Rigaud (1774–1839), the Savilian professor of astronomy, gave an "Account of some Early Proposals for Steam Navigation" to the Ashmolean Society. The latter part of the paper was taken up by a notice of the claim made that Blasco de Garay in 1543 at Barcelona made the first known experiment of propelling a vessel by the agency of steam. The claim was made in a book published in 1831, entitled "A Year in Spain by a Young American", the author being Capt. Slidell, U.S.N. Another notice had appeared in the *Literary Gazette* for 1827. "The critical examination of the question," said Rigaud, "must be left to those who have the advantage of being acquainted with the Spanish language, and have the opportunity of examining the original authorities, on which the statement depends. The Catalonians, indeed, were always the most enterprising people of the Peninsula ; but the machinery, necessary for the effect here described, seems to be beyond the age in which it is said to have been constructed, and it is difficult to persuade ourself implicitly of its existence".

The documents relating to the incident preserved at Simancas, near Valladolid, Spain, were examined in September 1857 by John Macgregor, who in a paper to the Royal Society of Arts, on April 14, 1858, stated that neither of the letters "contained any mention whatever of the use of steam".

The Royal Gardens

THE *Athenæum* of March 3, 1838, said : "Curiosity having been excited by a statement in the newspapers that the condition of the Royal Gardens has been the subject of an official inquiry, we have taken some pains to ascertain the truth of the report, and we find the facts to be as follows : A Committee has been appointed by the Lords of the Treasury to investigate certain matters connected with the Queen's Gardens at Windsor, Hampton Court, Kew, Kensington and Buckingham Palace ; and under the direction of the Committee, Professor Lindley has been lately engaged in a minute horticultural inquiry into the administration of these establishments. In this duty Dr. Lindley has associated with himself two gardeners of great experience, namely, Mr. Paxton, gardener to the Duke of Devonshire, and Mr. Wilson, gardener to the Earl of Surrey. We have reason to believe that a report has already been made, but as it relates to matters connected with her Majesty's household, we do not feel at liberty to make public the results of the inquiry."

Societies and Academies

Paris

Academy of Sciences, January 4 (*C.R.*, 206, 1–80).

ALFRED LACROIX : The Archives of the Academy of Sciences and the biographical index of its members and correspondants from 1666 to 1937.

MARCEL DELÉPINE and ALAIN HOREAU : The dimer of crotaldehyde. The hydrogenation of the corresponding acid and the transposition of its double bond by the nickel.

CHARLES EUGÈNE GUYE. The possibility of verifying experimentally the relation $\nu = \nu_0\sqrt{1-\beta^2}$ of limited relativity.

PAUL GILLIS : The multiple integrals of the calculus of variations.

ALFRED LIÉNARD : A particular case of the problem of Dirichlet for a circular ring.

MARCEL BRELOT : Some properties of sub-harmonic functions and of *balayage*.

LUCIEN MALAVARD : Electrical analogy as an auxiliary method of photo-elasticity.

DOUCHAN AVSEC : Vortices in transversal bands in a layer of air heated from below.

LOUIS GOLDSTEIN : The theory of nuclear reactions.

MME. MARIE ANTOINETTE TONNELAT-BAUDOT : The different forms of a function of action expressed with the aid of complex variables.

PIERRE VERNOTTE : Concerning a verification of Rayleigh's criterion.

LOUIS NÉEL : The interpretation of the paramagnetic Curie point of the elements of the rare earth group.

MARCEL ROUAULT : The structure of the $GeBr_4$ molecule. By the electron diffraction method, results have been obtained which agree with a tetrahedral structure for the molecule of germanium tetrabromide. The atomic distances found are Ge-Br, 2·32 A. and Br-Br, 3·79 A.

JEAN CAYREL : The Devaux reaction (copper, copper sulphide) on a limited surface.

ALEXANDRE TRAVERS and HAMID ZAHABI : Some properties of the hexahydrate of tricalcium aluminate and anhydrous tricalcium aluminate.

JEAN KRAFT : The uranyl ortho-arsenates.

RAYMOND CALAS : The preparation of two stereoisomeric $(d + 1)$ dihydrocamphorones.

PAUL GAUBERT : The formation and orientation of soft macled crystals in anisotropic liquid drops of *p*-axoxyanisol.

MLLES. WILFRIED HELLER and GERMAINE QUIMFE : The two possible orientations of colloidal goethite in the magnetic field.

MENGLI ENIKEFF : Researches on the soils of the interior delta of the Niger.

LOUIS DUBERTRET and HENRI VAUTRIN : The existence of the lacustrine Pontian in Syria and on its tectonic signification.

ANTONIN TRONCHET : The direct mechanical stimulation of the papillary cells of the tendrils of *Eccremocarpus scaber*.

ALBERT VANDEL : The existence of relations between the arrangement of the chromatophores and that of the muscular insertions in Isopods of the genus *Trichoniscus*.

THEODORE KOFMAN : Morphological reactions in the serum of the cancerized rabbit.

JEAN CUILLÉ and PAUL LOUIS CHELLE : The *Tremblante du mouton* is inoculable.

Amsterdam

Royal Academy (*Proc.*, 40, No. 10 ; 1937).

H. A. KRAMERS : The use of charge-conjugated wave-functions in the hole theory of the electron.

J. CLAY : Ionization and conductivity in gases at high pressures. Measurements of ionization in air, nitrogen, helium, neon, argon, krypton and xenon with cosmic rays and gamma rays.

J. G. VAN DER CORPUT : Weyl's method in the theory of numbers (3) : Two, three or four primes.

R. WEITZENBÖCK : Trivectors (3).

P. E. VERKADE and J. VAN DER LEE : Syntheses of glycero-phosphatidic acids and glycero-phosphatides.

E. DUBOIS : The osterone arrangement of the thigh-bone compacta of man identical with that first found in *Pithecanthropus*.

C. S. MEYER : Some further integral representations of products of Whittaker functions.

F. FLORSCHÜTZ and I. M. VAN DER VLERK : Fossil cell structure in Early Pleistocene deposits in the East Netherlands.

G. H. R. VON KOENIGSWALD : A lower jaw fragment of *Pithecanthropus* from the Trinil layers of central Java.

JEAN K. WESTON : Notes on the telencephalon of *Mormyrus* and *Gnathonemus*.

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 11, 1937).

L. GODEAUX : An algebraic surface of divisor two deduced from the surface of Veronese.

P. GÉRARD and R. CORDIER : Existence of glandular cells in the kidney of the *Aglossa*.

E. LAHAYE : Solution of Störmer's equations by real convergent integral iterations.

C. SURQUIN : Bernoulli's law in two variables.

O. ROZET : Cyclic involutions of order nine belonging to an algebraic surface.

L. J. TISON : Wear round bridge piers in a river.

A. GROSJEAN : Some observations on the northern border of the Liége coal-field.

Z. M. BACQ and A. OURY : Note on the distribution of choline esterase in living beings.

Rome

National Academy of the Lincei (*Atti*, 25, 413–524; 1937).

L. PETRI : Transmission of the leaf-curl virus of the vine through tissues of a resistant variety.

F. TRICOMI : Inversion formula of Widder.

L. CESARI : Resolution of systems of linear equations through successive approximations.

G. POMPILJ : Cremona transformations of the plane which has a curve of united points.

L. TOSCANO : Deviation of the permutability in the theory of linear operators.

M. VILLA : Varieties in four dimensions which possess ∞^7 conics which are quasi-asymptotics γ_{57}.

G. COLONNETTI : Elastic equilibrium of systems in which non-elastic deformations also occur (2).

G. LAMPARIELLO : Kinetic interaction between vortices and irrotational currents.

M. LOMBARDINI : Gradient wind.

C. POSSIO : Rotational motion of gases.

G. L. ANDRISSI : Variation of the latitude of the Royal Astronomical Observatory on the Capitol from 1920 to 1934 (2).

S. FRANCHETTI: Calculation of the penetration of electrons of some million volts (1).

G. RACAH: Isotropic tensors which show particular symmetries (1).

P. GUARESCHI: (1) Considerations regarding the rapid and approximate calculation of the specific heats of liquids. (2) Association coefficients and their variations as a function of temperature.

A. BANCHETTI: Reformatsky's reaction carried out on benzamide.

G. B. BONINO and R. MANSONI-ANSIDEI: (1) Lines attributed to a possible pyrrolenine form in the Raman spectrum of pyrrole. (2) Raman spectrum of *N*-deuteropyrrole.

A. IANDELLI and E. BOTTI: Crystal structure of compounds of the rare earths with metalloids of the fifth group. (3) Arsenides and antimonides of lanthanum, cerium and praseodymium.

G. B. BONINO: Molecular symmetry of pyrrole.

L. CAVALLARO: Absorption bands in polar substances at very high radio-frequencies (2).

M. BOLLI: Researches on amylases.

Vienna

Academy of Sciences, December 16.

MARIETTA BLAU and HERTHA WAMBACHER: Photographic investigation of heavy particles in cosmic rays. A number of proton tracks, having a mean energy of 12×10^8 e.v., have been recorded. These appear to be secondary particles, as there is no directional effect. Thirty-one nuclear disintegrations have also been recorded, and the energy released in each is estimated to be more than 200×10^6 e.v.

J. STINY: Structure of the Obir mountain and east–west displacements.

F. SEIDL: Dielectric constants and electrical conductivities of annealed and dehydrated Rochelle salt.

O. AMPFERER: Junction of the east and west Alps at the Rhine valley.

F. WESSELY, H. HIRSCHEL, G. SCHLÖGL-PETZIWAL and F. PRILLINGER: Constitution of equol.

A. DEMMELMAIR: Variation of cosmic ray intensity on the Hafelekar according to local and sidereal time. No fluctuation with a period of one sidereal day could be established; but there was a period of one solar day. The maximum occurred at midday and the minimum at midnight. There was also a definite yearly period, the maximum being in the winter.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 595–637, Dec. 15).

G. H. PARKER: (1) Antidromic responses from the melansphore nerves of the catfish *Ameinrus*. (2) Antagonism in neurohumours as seen in the pectoral bands of *Mustelus*. Cuts across the fin of this dogfish produce a pale band which extends practically to the edge of the fin and has straight sides or irregular sides according as the fish are blanching or darkening respectively. This and other effects are believed to be due to the presence, simultaneously, of the dispersing neurohumour intermedin (causing darkening) and a concentrating lipohumour from the nerves (causing blanching).

E. H. HALL: The four transverse magnetic effects in copper: new measurements. Measurements have been made of the Hall, Ettingshausen, Nernst and Righi-Leduc effects, at temperatures ranging from 20° to 90° C. Using the figures for the Hall and Ettingshausen coefficients, values for the other two can be calculated by the author's theory of dual conduction in metals. The results are in fair agreement with the experimental values.

P. S. EPSTEIN: Magnetic energy of supraconductors.

C. SOBUTSKY, L. F. ANDRIETH and R. W. CAMPBELL: Acid catalysis in liquid ammonia. (1) Ammonolysis of diethylmalonate. Liquid ammonia reacts directly with many substances, the reaction being similar to hydrolysis and hence known as ammonolysis. As hydrogen ion often catalyses hydrolysis, so ammonium ion is found to catalyse ammonolysis. Diethylmalonate in liquid ammonia gives malonamide, the yield increasing with the concentration of ammonium chloride added. Equivalent concentrations of different ammonium salts were roughly equally effective.

L. PAULING and J. H. STURDIVANT: Structure of cyameluric acid, hydromelonic acid and related substances. X-ray analysis leads to the view that these substances contain a trivalent cyameluric nucleus C_6N_7, consisting of a co-planary arrangement of three fused rings, and resembling the cyanuric nucleus C_3N_3.

RICHARD GOLDSCHMIDT: Spontaneous chromatin rearrangements and the theory of the gene. As a result of innumerable repetitions of pair-breeding in pure stocks of *Drosophila* or in simple crosses involving mutants in a rather labile equilibrium, it is concluded that all so-called gene mutations are chromatin rearrangements. The chromosome is the unit, and a definite order within its texture is required for normal development.

J. D. HARDY and E. F. DUBOIS: Regulation of heat loss from the human body. Two normal men were studied nude in the large respiration chamber of the Russell Sage Institute of Pathology, New York, in environments ranging from 23° C. to 35° C. under basal and other conditions. No seasonal changes were found from experiments in winter, spring and early summer. Among other results, it is found that regulation of heat loss at 30° and higher is by a combination of increased blood flow to the skin and by vaporization, and is more sensitive between 30° and 35° than in any other range of temperature. Vasomotor regulation of heat loss is effective down to about 28·5°; below this point, heat loss becomes progressively greater than that produced, until a chill is experienced. During periods of basal metabolism, heat loss by radiation is a maximum and that by convection a minimum; convection loss only is increased during a chill. During a chill, heat production increased to 100–150 per cent above basal, while heat loss increased only 10–15 per cent.

J. D. HARDY: Physical laws of heat loss from the human body. An examination of heat loss from a metal cylinder of known dimensions in the calorimeter used for human subjects (see preceding paper). The proportion of radiation loss to convection loss at 25–26° C. is about the same for the human body and the metal cylinder. Applying Newton's law of cooling, it is deduced that 78 per cent of the area of the human body is effective in radiating heat in the position used. Between 28° and 23°, heat is transferred through the body tissues by pure conduction. Above this range, thermal conductance begins to increase, due presumably to increase of superficial blood flow.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Tuesday, March 1

QUEEN MARY COLLEGE, at 5.30.—Sir John Russell, F.R.S.: "South Russia".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—(Joint Meeting with other bodies). Symposium on "The Essential Road Conditions governing the Safety of Modern Traffic".

Wednesday, March 2

ROYAL SOCIETY OF ARTS, at 8.15.—E. V. Evans: "Coal Carbonisation and its Importance in the Life of the Nation".

Thursday, March 3

ROYAL SOCIETY, at 4.30.—Prof. J. H. Orton, J. W. Jones and G. M. King: "The Male Sexual Stage in Salmon Parr (*Salmo salar juv.*)".

H. Grüneberg: "An Analysis of the 'Pleiotropic' Effects of a New Lethal Mutation in the Rat (*Mus norvegicus*)".

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. C. C. Ungley: "Some Deficiencies of Nutrition and their Relation to Disease." (Goulstonian Lectures. Succeeding lectures on March 8 and 10.)

Friday, March 4

GEOLOGISTS' ASSOCIATION (in the Architectural Theatre, University College, London), at 7.30.—Annual General Meeting.

P. McIntyre: "Alps and Glaciers" (Presidential Address).

ROYAL INSTITUTION, at 9.—Prof. D. Brunt: "Gliding and Soaring Flight".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR INSPECTOR to the Royal Commission on Ancient Monuments (Wales)—The Secretary, Sanctuary Buildings, 20 Great Smith Street, S.W.1 (March 2).

ASSISTANT LECTURER IN AGRICULTURE in the Herts Institute of Agriculture—The Deputy Clerk of the Herts County Council, 28 Castle Street, Hertford (March 3).

ASSISTANT ARCHÆOLOGIST to the Royal Commission on Ancient and Historical Monuments (Scotland)—The Secretary, 27 York Place, Edinburgh, 1 (March 9)

ASSISTANT INVESTIGATOR (roof control and haulage) to the Safety in Mines Research Board, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1—The Under-Secretary for Mines (March 12).

ELECTRICAL ENGINEER in the Military Academy of Science, Woolwich, S.E.18—The Commandant (March 8).

ASSISTANTS (Grade III, metallurgy), SCIENTIFIC OFFICER, and ASSISTANT (Grade III, aerodynamics) at the Royal Aircraft Establishment, South Farnborough, Hants—The Superintendent (March 12).

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

National Institute of Industrial Psychology. Report 7: Improving the Blackboard. By W. Douglas Seymour. Pp. 35. (London: National Institute of Industrial Psychology.) 1*s.* 6*d.* [271

Imperial Institute. Annual Report, 1937. Pp. 71. (London: Imperial Institute.) [271

University of Leeds. The Second Annual Report of the Brotherton Collection Committee. Pp. 8. Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (John W. Cobb) for the Session 1936–37. Pp. 12. (Leeds: The University.) [281

The Film in relation to the School Curriculum. By Ethel Green and William L. Lally. Pp. 69. (London: Central Information Bureau for Educational Films, Ltd.) 1*s.* [281

Other Countries

Smithsonian Miscellaneous Collections. Vol. 97, No. 2: Plant Growth in relation to Wave-Length Balance. By Earl S. Johnston. (Publication 3446.) Pp. 18+4 plates. (Washington, D.C.: Smithsonian Institution.) [281

Indian Forest Records (New Series). Vol. 3, No. 7: Four New Indian Ichneumonidæ. By R. A. Cushman. Pp. 141–148. (Delhi: Manager of Publications.) 4 annas; 5*d.* [281

Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1936; together with the Thirtieth Annual Report of the Central Committee of the Association for the Year ending 31st March 1937. Pp. 89. (Madras: Madras Publishing House, Ltd.) [281

Gold Coast. Report on the Forestry Department for the Year 1936–37. Pp. iii+10+2 plates. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s.* [281

Ministry of Agriculture, Egypt: Technical and Scientific Service Bulletin No. 184: The Effect of Temperature on Locust Activity. By M. Hussein. Pp. v+55+13 plates. P.T. 10. Bulletin No. 185: La sériciculture en Egypte: Moisissure noire des cocons *Aspergillus pheonicis* (Corda). Par Dr. Wadih M. Carobin. Pp. 6+5 plates. P.T. 1. (Cairo: Government Press.) [281

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